Capture and Transport of Juvenile Coho (*Oncorhynchus kisutch*) and Steelhead *(O. mykiss*) Salmon Past the Cleveland Dam on the Capilano River in 2001 and 2002 with an Assessment of Upper Capilano River Production

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CAPTURE AND TRANSPORT OF JUVENILE COHO (*Oncorhynchus kisutch*) AND STEELHEAD (*O. mykiss*) SALMON PAST THE CLEVELAND DAM ON THE CAPILANO RIVER IN 2001 AND 2002 WITH AN ASSESSMENT OF UPPER CAPILANO RIVER PRODUCTION

by

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CONTENTS

LIST OF FIGURES iv

LIST OF TABLES v

LIST OF APPENDICES vii

ABSTRACT viii

RÉSUMÉ viii

INTRODUCTION 1

METHODOLOGY 2
COHO AND STEELHEAD SALMON SMOLT TRAPPING 2
Fish Capture and Transport 2
Environmental and Biological Sampling 5
Population Estimates 6
SPILLWAY PASSAGE SURVIVAL RATE 7
UPPER CAPILANO RIVER PRODUCTIVITY ASSESSMENT 8

RESULTS AND DISCUSSION 8
COHO AND STEELHEAD SALMON SMOLT TRAPPING 8
Fish Capture and Transport 8
Environmental Sampling 12
Biological Sampling 14
Population Estimates 17
Project Assessment and Recommendations 20
SPILLWAY PASSAGE SURVIVAL RATE 23
Fish Capture 23
Environmental Sampling 25
Biological Sampling 27
Population Estimate 27
Project Assessment and Recommendations 28
UPPER CAPILANO RIVER PRODUCTIVITY ASSESSMENT 31

ACKNOWLEDGEMENTS 35

REFERENCES 36

APPENDICES 39

LIST OF FIGURES

Figure 1. Location of the Capilano River watershed in southwestern British Columbia, Canada....2

Figure 2. Study area of the Capilano River watershed coho and steelhead salmon smolt capture and transport project....3

Figure 3a. Upper Capilano River profile and trap positions at the Lakehead Bridge site in 2001....4

Figure 3b. Upper Capilano River profile and trap positions at the Lakehead Bridge site in 2002....5

Figure 4. Daily river level and catch of coho salmon smolts in the RSTs deployed in the upper Capilano River in 2001. An "R" indicates a release of marked coho smolts....9

Figure 5. Daily river level and catch of steelhead salmon smolts in the RSTs deployed in the upper Capilano River in 2001....9

Figure 6. Daily river level and catch of coho salmon smolts in the RSTs deployed in the upper Capilano River in 2002. An "R" indicates a release of marked coho smolts....11

Figure 7. Daily river level and catch of steelhead salmon smolts in the RSTs deployed in the upper Capilano River in 2002....12

Figure 8. Daily river level and water temperature at the Lakehead Bridge trapping site in the upper Capilano River in 2001....13

Figure 9. Daily river level and water temperature at the Lakehead Bridge trapping site in the upper Capilano River in 2002....13

Figure 10. Average nose-fork length, by sampling date, for coho salmon smolts captured in the upper Capilano River in 2001 and 2002. Bars equal ± one standard deviation. Linear regression lines are shown....15

Figure 11. Average nose-fork length, by sampling date, for steelhead salmon smolts captured in the upper Capilano River in 2001 and 2002....15

Figure 12. Daily catch of coho salmon smolts in the RST deployed in the lower Capilano River in 2001. An "R" indicates a release of marked coho smolts....24

Figure 13. Regression relationship between the daily percentage of category II (dead or not expected to survive) coho salmon smolts captured in the lower Capilano River RST below Cleveland dam and Cleveland dam spillway discharge in 2001....26

Figure 14. Daily discharge from the Cleveland dam spillway in 2001. An "R" indicates a release of marked coho salmon smolts....26

LIST OF TABLES

Table 1. Total catch of coho and steelhead salmon smolts, by trap position, in the upper Capilano River in 2001 and 2002. 10

Table 2. Average nose-fork length (NFL), weight and condition factor (K value), along with standard deviation (SD) in brackets, by sample date, for coho and steelhead salmon smolts captured in the upper Capilano River in 2001. 14

Table 3. Average nose-fork length (NFL), weight and condition coefficient (K value), along with standard deviation (SD) in brackets, by sample date, for coho and steelhead salmon smolts captured in the upper Capilano River in 2002. 16

Table 4. Ages, based on scale analysis, of coho salmon smolts captured in the upper Capilano River in 2001 and 2002. 17

Table 5. Marked releases, unmarked catch and marks recaptured of coho salmon smolts in the upper Capilano River in 2001 and 2002. 17

Table 6. Incidence of marked coho salmon smolts recaptured, by trapping site, in the RSTs deployed in the upper Capilano River in 2001. 18

Table 7. Proportion of marked coho salmon smolts recaptured, by period, in the RSTs deployed in the upper Capilano River in 2001. 18

Table 8. Stratified population estimates for coho salmon smolts emigrating from the upper Capilano River in 2001. 19

Table 9. Incidence of marked coho salmon smolts recaptured, by trapping position, in the RSTs deployed at the Lakehead Bridge site in the upper Capilano River in 2002. 19

Table 10. Proportion of marked coho salmon smolts recaptured, by period, in all of the RSTs deployed in the upper Capilano River in 2002. 20

Table 11. Stratified population estimates for coho salmon smolts emigrating from the upper Capilano River in 2002. 20

Table 12. Number of days and marked release groups and coho salmon smolts captured, stratified by river level range, in the upper Capilano River in 2002. 22

Table 13. Monthly summary of the total catch of category I and II coho and steelhead salmon smolts, with average spillway discharge, in the Capilano River below Cleveland dam in 2001 24

Table 14. Proportion of category I and II coho and steelhead salmon smolts captured, stratified by spillway discharge, in the Capilano River below Cleveland dam in 2001 25

Table 15. Ages, by length category, of coho salmon smolts captured in the lower Capilano River below the Cleveland dam spillway in 2001. 27

Table 16. Proportion of marked coho salmon smolts recaptured, by period, in the RST deployed in the lower Capilano River below the Cleveland dam spillway in 2001. 28

Table 17. Stratified population estimate for coho salmon smolts migrating past the trapping site in the lower Capilano River in 2001. 28

Table 18. Number of days and marked release groups and coho salmon smolts captured, stratified by spillway discharge, in the Capilano River below Cleveland dam in 2001 30

Table 19. Details of all Capilano Salmon Hatchery fry releases into the upper Capilano River for the brood years ranges 1998 to 2000 and 1997 to 2001 for coho and steelhead salmon, respectively. 31

Table 20. Details of all Capilano Salmon Hatchery adult coho salmon releases into the upper Capilano River for the years 1998 to 2000. 32

Table 21. Estimates of brood year contribution to the total number of coho salmon smolts produced in the upper Capilano River in 2001 and 2002. 32

Table 22. Total production estimates, by brood year, of coho salmon smolts from the upper Capilano River for the years 1998 to 2000. 33

Table 23. Summary of survival rates required to produce the estimated coho salmon smolt population from the release of 1999 brood year coho salmon fry and adults. 33

LIST OF APPENDICES

Appendix 1. Details of the trap box baffling system implemented in 2002. 40

Appendix 2. Daily catch of juvenile coho salmon, by trap position, in the upper Capilano River in 2001 41

Appendix 3. Daily catch of juvenile steelhead salmon, by trap position, in the upper Capilano River in 2001. 44

Appendix 4. Daily catch of live and dead coho and steelhead salmon smolts in the RSTs deployed in the upper Capilano River in 2001. 47

Appendix 5. Daily catch of coho salmon smolts, by trap position, in the upper Capilano River in 2002 50

Appendix 6. Daily catch of steelhead salmon smolts, by trap position, in the upper Capilano River in 2002 53

Appendix 7. Daily catch of live and dead coho and steelhead salmon smolts in the RSTs deployed in the upper Capilano River in 2002. 55

Appendix 8. Environmental data collected at the Lakehead Bridge site, upper Capilano River in 2001 and 2002. 58

Appendix 9. Nose-fork length, weight and condition coefficient (K value), by sample date, for coho and steelhead salmon smolts captured in the upper Capilano River in 2001 61

Appendix 10. Nose-fork length, weight and condition coefficient (K value), by sample date, for coho and steelhead salmon smolts captured in the upper Capilano River in 2002 70

Appendix 11. Summary, by date, of the coho salmon smolt mark recapture study conducted on the upper Capilano River in 2001. 82

Appendix 12. Summary, by date, of the coho salmon smolt mark recapture study conducted on the upper Capilano River in 2002. 86

Appendix 13. Daily catch, by condition factor, of coho salmon smolts in the RST deployed below the Cleveland Dam spillway in the lower Capilano River in 2001. 90

Appendix 14. Daily catch, by condition factor, of steelhead salmon smolts in the RST deployed below the Cleveland Dam spillway in the lower Capilano River in 2001. 92

Appendix 15. Daily discharge and other related parameters of the Capilano Reservoir and Cleveland Dam in 2001. Data are from the Greater Vancouver Water District. 93

Appendix 16. Biological sampling data collected from coho salmon smolts captured below the Cleveland Dam spillway in 2001. 96

Appendix 17. Annual transport of adult coho and steelhead salmon upstream of the Cleveland dam. 100

Appendix 18. Historical releases of fed and unfed coho and steelhead salmon fry from the Capilano Salmon Hatchery. 101

ABSTRACT

Diewert, R.E., Evers, S., Dickson, R., Tadey, J.A. and Galbraith, R.V. 2004. Capture and transport of juvenile coho (*Oncorhynchus kisutch*) and steelhead (*O. mykiss*) salmon past the Cleveland dam on the Capilano River in 2001 and 2002 with an assessment of upper Capilano River production. Can. Manuscr. Rep. Fish. Aquat. Sci. 2667: viii + 101 p.

In 2001, the Greater Vancouver Water District (GVWD) initiated construction work on the Cleveland dam in the Capilano River. This prevented the downstream migration of coho and steelhead salmon smolts rearing upstream of the dam. To help mitigate this situation smolts were trapped upstream of the reservoir and transported to a release site below the dam. In 2001, 4,821 coho and 236 steelhead salmon smolts were transported. In 2002, 16,971 coho and 215 steelhead salmon smolts were transported. A simple stratified mark recapture technique estimated the production of coho salmon smolts upstream of the reservoir as 55,318 in 2001 (95 % CI: 41,937 to 68,700) and 47,448 in 2002 (95% CI: 43,509 to 51,386). Survival of coho and steelhead salmon smolts travelling over the Cleveland dam spillway was estimated to be 23.3% and 61.5%, respectively. An assessment of coho salmon productivity in the upper Capilano River suggested that 1999 stocking levels likely did not exceed the carrying capacity of the watershed.

RÉSUMÉ

Diewert, R.E., S. Evers, R. Dickson, J.A. Tadey and R.V. Galbraith. 2003. Capture and transport of juvenile coho (*Oncorhynchus kisutch*) and steelhead (*O. mykiss*) salmon past the Cleveland dam on the Capilano River in 2001 and 2002 with an assessment of upper Capilano River production. Can. Manuscr. Rep. Fish. Aquat. Sci. 2667: viii + 101 p.

En 2001, le Greater Vancouver Water District a entrepris des travaux de construction au barrage Cleveland sur la rivière Capilano. Ces travaux ont empêché l'avalaison des saumons cohos et arc-en-ciel juvéniles (saumoneaux) nés en amont du barrage. Afin de limiter les répercussions de ces travaux, des saumoneaux ont été capturés en amont du réservoir, puis relâchés en aval du barrage. Ont été transportés en 2001, 4 821 saumons cohos et 236 saumons arc-en-ciel, et en 2002, 16 971 saumons cohos et 215 saumons arc-en-ciel. Une technique simple et stratifiée de marquage-recapture a permis d'estimer la production de saumoneaux cohos en amont du réservoir à 55 318 en 2001 (I.C. à 95 % : de 41 937 à 68 700) et à 47 448 en 2002 (I.C. à 95 % : de 43 509 à 51 386). Les taux de survie des saumoneaux cohos et arc-en-ciel qui franchissent naturellement le déversoir du barrage Cleveland ont été estimés respectivement à 23,3 % et 61,5 %. Une évaluation de la production de saumons cohos dans le cours supérieur de la rivière Capilano suggère que l'empoissonnement en 1999 n'a probablement pas été supérieur à la capacité de charge du bassin hydrographique de la rivière.

INTRODUCTION

The Capilano River originates near Capilano Mountain at an elevation of 562 m above sea level (Figure 1). The river drains an area of 190 km^2 and flows in a southerly direction for approximately 35 km through North and West Vancouver, British Columbia, before entering Burrard Inlet near the First Narrows Bridge (Figure 2) (Fedorenko and Perry 1991). In 1888, the river was partially dammed and a domestic water intake was built about 10 km from the river mouth. The original dam was replaced further downstream by the present Cleveland dam in 1954, creating Capilano Lake, a 5.6 km reservoir that now supplies 40% of the Lower Mainland's domestic water (Harbour Publishing Internet Document 2000; accessed 23 June, 2004). The construction of the dam blocked the migration route of adult coho and steelhead salmon travelling up the Capilano River to spawn. More than 95% of the spawning habitat and 75% of the rearing habitat became inaccessible as a result of the dam. To mitigate this loss, the Greater Vancouver Water District (GVWD) constructed a concrete weir and fish ladder that collected adult spawners for transport above the dam. However, since juvenile salmon migrating downstream had to pass over the dam, resulting in high levels of mortality, the Capilano River salmon stocks declined dramatically. To address this problem, the Department of Fisheries and Oceans built the Capilano Salmon Hatchery to rear and release juvenile salmon below the dam. Construction began in 1969 and was completed in 1971 (Fisheries and Oceans Internet Document 2002; accessed 23 June 2004).

Coho salmon escapements to the Capilano River ranged from 3,500 to 7,000 before dam construction. Returns to the river declined to an average of 2,000 fish in the 1960's and early 1970's (Fedorenko and Perry 1991). Since the start of hatchery production in 1973, coho salmon returns to the Capilano Salmon Hatchery have averaged approximately 14,000 annually (Fisheries and Oceans Internet Document 2002; accessed 23 June 2004). This value represents the number of coho salmon that actually swim into the hatchery and does not include substantial numbers of fish that are captured each year in the recreational and First Nation's fisheries that operate in the river downstream of the hatchery facility.

Steelhead salmon returns to the Capilano River ranged from 1,500 to 2,000 before dam construction (Larkin and Hourston 1951). Since the start of hatchery production in 1973, approximately 15,000 steelhead smolts have been released into the river each year (Fisheries and Oceans Internet Document 2002; accessed 23 June 2004). It is difficult to assess steelhead population status because the majority of steelhead adults do not actually return to the hatchery; however, a very active recreational steelhead fishery operates in the river harvesting numerous fish each year.

In 2001, the GVWD initiated construction work on the east abutment of the Cleveland dam to control seepage. To facilitate this effort, the water level in the reservoir was lowered well below the level of the dam spillway. As a result, coho and steelhead salmon smolts migrating downstream from rearing areas in the upper Capilano River were unable to travel past the dam en route to the ocean. To help mitigate this situation, the GVWD provided funding in 2001 and 2002 to Fisheries and Oceans Canada, Habitat and Enhancement Branch, to trap coho and

steelhead salmon smolts upstream of the reservoir and to transport these fish to a release site below the dam.

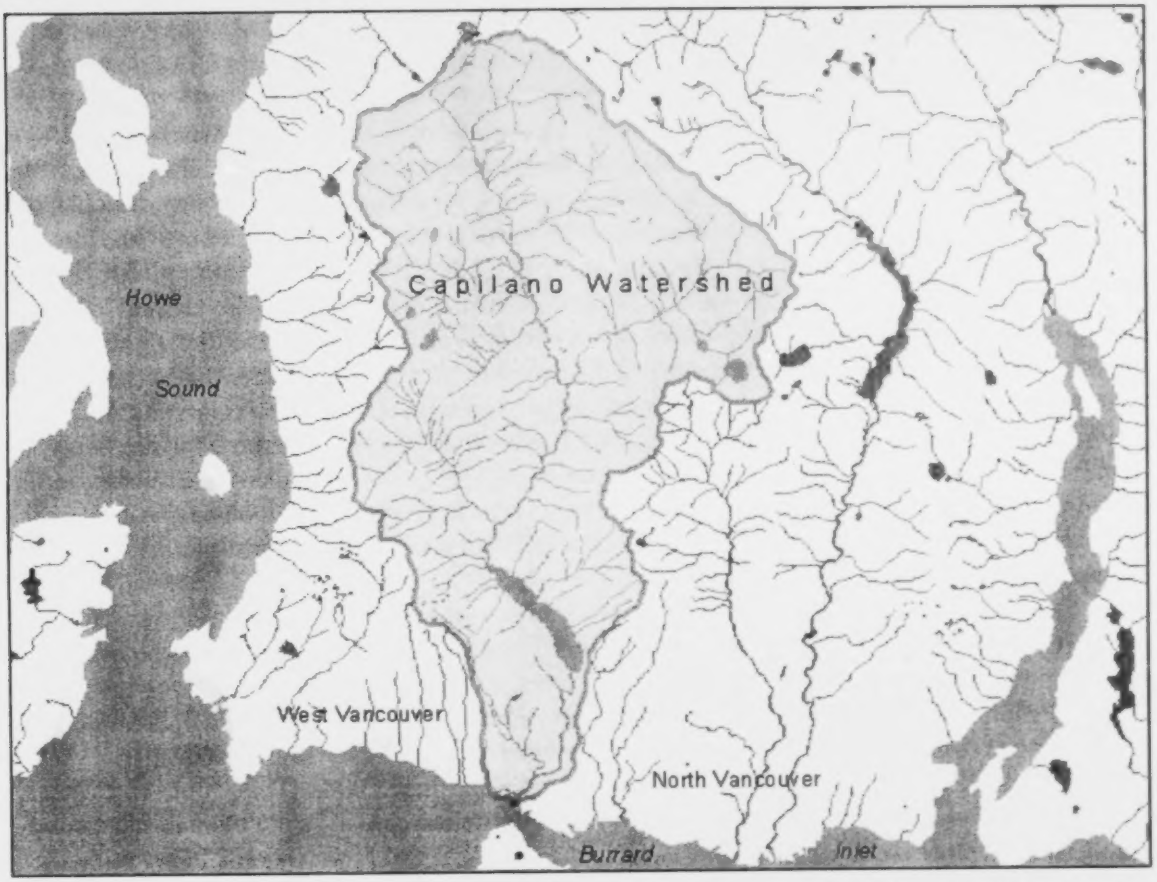


Figure 1. Location of the Capilano River watershed in southwestern British Columbia, Canada.

As part of this project, fisheries staff also estimated coho salmon smolt production from the upper Capilano River upstream of the reservoir and estimated the survival rate for coho and steelhead salmon smolts that pass over the Cleveland dam spillway. In addition, the productive capacity of the upper Capilano River for coho salmon smolts was assessed and extensive biological and environmental data were collected.

METHODOLOGY

COHO AND STEELHEAD SALMON SMOLT TRAPPING

Fish Capture and Transport

Auger, or rotary screw traps (RSTs), were deployed in the upper Capilano River to capture juvenile coho and steelhead salmon migrating downstream. As the trap cones rotated in

the water column, migrating fish were captured, along with a volume of water sampled by the cone, and moved through to a live box situated at the downstream end of the trap. The cones of the RSTs were set up with 12 mm galvanized screens. Traps were accessed at least once a day by jet boat or from shore depending on river level and trap location. All fish captured were enumerated by species and either held for later transport to a release site below the dam or marked and held for use in the population estimation study.

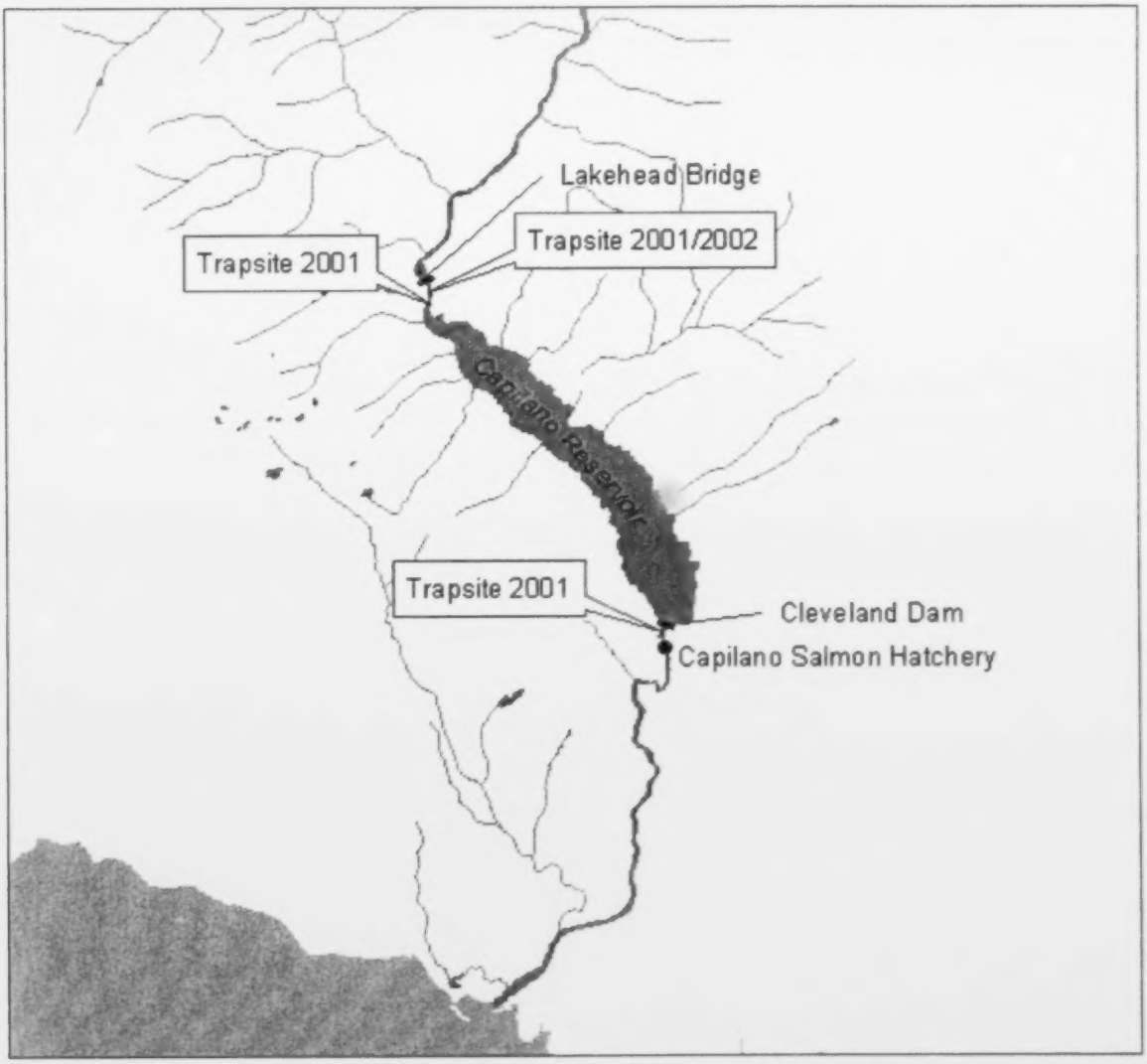
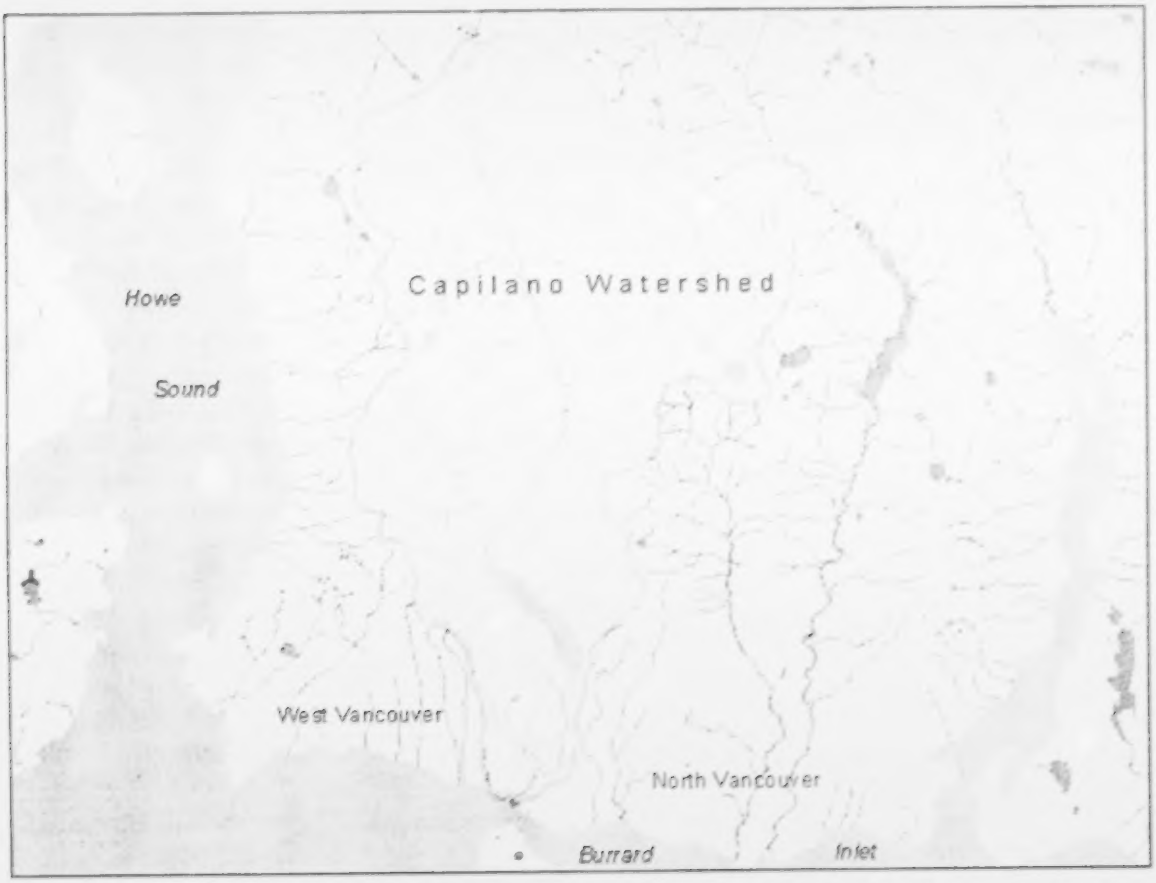


Figure 2. Study area of the Capilano River watershed coho and steelhead salmon smolt capture and transport project.

In 2001, two traps with cone diameters of 2.4 m were deployed in the upper Capilano River. The first trap was situated approximately 350 m upstream of the reservoir and immediately downstream of the Lakehead Bridge (Figure 2). Cables attached to the bridge held the RST in position (P1, P2 and P3) so that the trap could be moved across the width of the river

steelhead salmon smolts upstream of the reservoir and to transport these fish to a release site below the dam.



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to fish with maximum efficiency at each water level (Figure 3a). The second trap was deployed immediately upstream of the reservoir in the main flow of the river and was held in position with 45 lb "Davis Talon" anchors that were attached to the trap with a combination of cable, chain and polypropylene rope (Figure 2).

In 2002, four rotary screw traps were deployed in the upper Capilano River. Three traps had a cone diameter of 2.4 m while the cone diameter of the fourth trap was 1.5 m. All of the RSTs were deployed immediately downstream of the Lakehead Bridge (Figure 2). A total of six fishing positions were established (P1 to P6) and traps were moved as required to maximize capture efficiency at various water levels (Figure 3b).

The RST holding boxes were modified in 2002 to enhance fish removal and to reduce fish mortality. To accomplish the first goal, all hiding places were eliminated and square, flush corners were created to improve fish capture with the dip net. To accomplish the second goal, two sets of baffles were installed to create calm water areas where fish could take refuge especially during periods of high flow (Appendix 1).

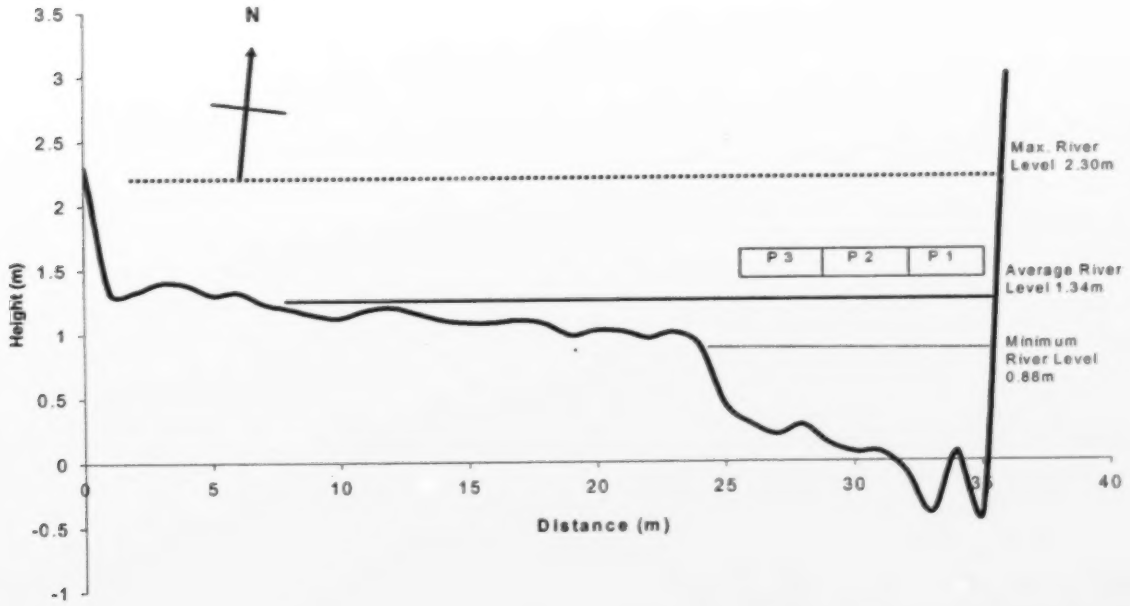

Figure 3a. Upper Capilano River profile and trap positions at the Lakehead Bridge site in 2001.

Dip nets were used to remove smolts from the RST trap boxes and transfer them to 18 L buckets filled with river water and equipped with battery operated aerators. The buckets were carried up the bank of the river and smolts were deposited into a 1,000 L truck mounted transport tank filled with river water. A battery-operated aerator with four air stones bubbled ambient air into the transport tank. Dissolved oxygen (DO) levels were monitored during transport and an oxygen cylinder was available as a back up system in case DO levels became too low. Dissolved

oxygen levels in the transport tank never fell below 9 mg•L^{-1}. The accepted one-day minimum DO level for juvenile and adult salmonids is 5 mg•L^{-1} (Anon 1997).

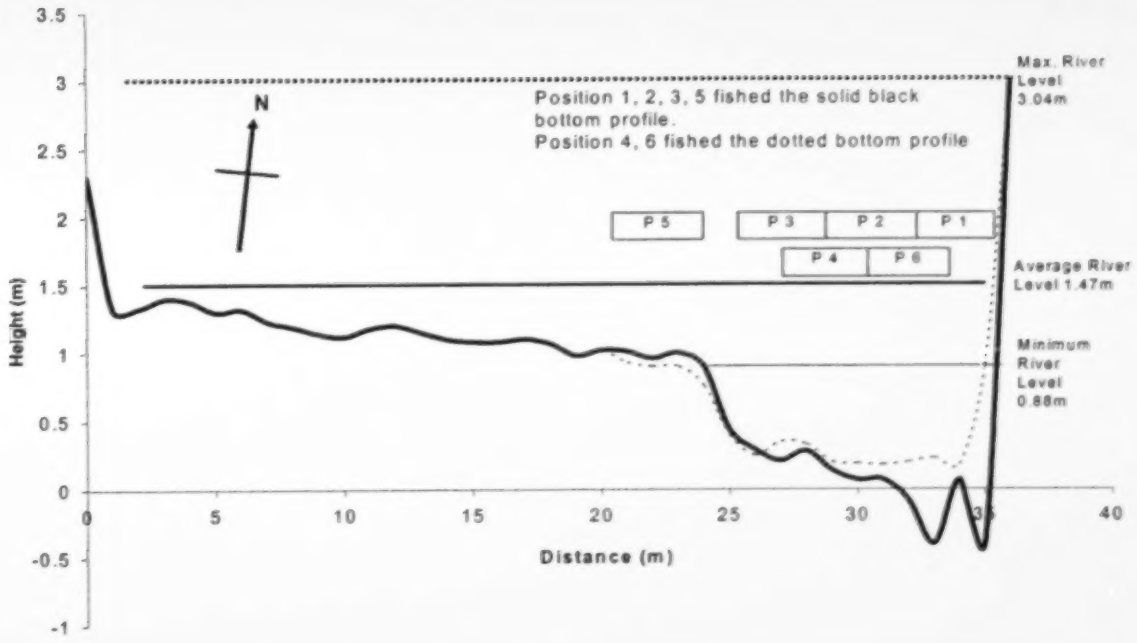

Figure 3b. Upper Capilano River profile and trap positions at the Lakehead Bridge site in 2002.

When traps were accessed by jet boat, smolts were moved from the 18 L buckets into aerated 75 L pails secured to the bottom of the boat. The smolts were then transported approximately 250 m downstream to the boat launch area at the mouth of the reservoir. Here the smolts were once again deposited into the truck-mounted transport tank.

Fish were generally in the 18 L buckets for less than 30 minutes before being placed in the truck-mounted transport tank. On some days, fish were held in the transport tank for periods of up to two hours while traps were repaired or repositioned. During these periods, dissolved oxygen levels were constantly monitored and adjusted as necessary. All smolts were transported from the capture site to the Capilano Salmon Hatchery downstream of the dam where they were released at the top to the hatchery fishway. Transit time to the release site was approximately 20 minutes. The release site was considered ideal as it provided smolts with refuge areas, highly oxygenated water, and easy access to the main flow of the river.

Environmental and Biological Sampling

Environmental data including river level, water temperature and general weather conditions were recorded daily. Biological sampling included the collection of length and weight data from a subsample of all coho and steelhead salmon smolts captured. With this biological data an index of well being (i.e. condition coefficient or K value) was calculated. Condition

coefficients are more easily interpreted and compared than a simple weight-length relationship (Anderson and Gutreuter 1983). The K value falls into the group of Fulton-type condition coefficients for whole fish (Anderson and Gutreuter 1983) and is of the form:

$$K = \left(\frac{W}{L^3}\right) \times X$$

where:

W = weight in grams
L = nose-fork length in millimetres
X = a scaling constant equal to 100,000

Scale smears were taken from a subsample of coho salmon smolts captured at each site for later age analysis.

Population Estimates

A portion of the coho salmon smolts captured during each year of the program was anaesthetized using CO_2 and marked with a Micro-jet dye and/or fin clip. After marking, smolts were transported approximately 300 m upstream of the Lakehead Bridge site and placed in a 1.2 by 1.5 by 1.2 m holding pen situated in a calm back channel of the river. At dusk, the marked fish were released into the main flow of the river near the tail-out of a small pool.

A stratified mark recapture technique with sampling at one location was used to estimate the abundance of coho salmon smolts migrating downstream. Since sampling occurred at only one site, a portion of the fish captured were marked and released upstream of the trapping site. As a result, the objective was to estimate the size of the unmarked population since the total count of captures included the sample of marked smolts (Carlson *et al.* 1998). For each stratum, the fundamental estimator was therefore a Peterson estimate of the unmarked population. The procedure, as outlined in Carlson *et al.* (1998), is partly reproduced below. The method consists of determining capture probability (trap efficiency), which is used to estimate total abundance for a segment of the population. Each trap efficiency trial is temporally stratified and discretely paired with one capture period. This approach accounts for potential temporal changes in capture probability.

The following notation definitions apply to all subsequent equations:

h = stratum index (capture period and a corresponding trap efficiency trial),
M_h = number of marked coho salmon smolts released in stratum h,
m_h = number of marked coho salmon smolts recaptured in h,
u_h = number of unmarked coho salmon smolts captured in h,

U_h = total coho salmon smolt population size in h, excluding marked releases and observed mortality,

U = total coho salmon smolt population size, excluding marked releases,

$\hat{U}_h$ = the approximately unbiased estimate of U_h,

$\hat{U}$ = the approximately unbiased estimate of U,

$v(\hat{U}_h)$ = the approximately unbiased variance estimate of $\hat{U}_h$,

$v(\hat{U})$ = the approximately unbiased variance estimate of $\hat{U}$.

An approximately unbiased estimate of U_h is:

$$\hat{U}_h = \frac{u_h(M_h+1)}{m_h+1}$$

An approximately unbiased variance estimate of $\hat{U}_h$ is:

$$v(\hat{U}_h) = \frac{u_h(M_h+1)(u_h+m_h+1)(M_h-m_h)}{(m_h+1)^2(m_h+2)}$$

The total population estimate $\hat{U}$, is the sum of $\hat{U}_h$ across all strata while the total variance estimate $v(\hat{U})$, is the sum of $v(\hat{U}_h)$ across all strata. An approximate 95% confidence interval for $\hat{U}$ is:

$$\hat{U} \pm 1.96\sqrt{v(\hat{U})}$$

SPILLWAY PASSAGE SURVIVAL RATE

During the spring of 2001, a single RST with a cone diameter of 2.4 m was deployed in the lower Capilano River immediately downstream of the Cleveland dam spillway. A portion of the juvenile coho and steelhead salmon smolts passing over the spillway from the Capilano River reservoir were captured in the trap as they continued their downstream migration. The trap was checked at least once a day and all fish captured were enumerated by species. The condition of each fish was also assessed and categorized as follows: A = excellent – fish is lively with no scale loss or bruising and no obvious signs of stress; B = satisfactory – a few scales lost but the fish is lively with little or no obvious signs of stress; C = poor – fish has noticeable scale loss with a little bruising and shows obvious signs of stress; D = moribund – fish is near death with lots of scale loss, bruising and shows significant signs of stress; and E = dead. Stress was defined based on abnormal swimming behaviour at release. Length and weight data were collected from a subsample of all coho and steelhead salmon smolts captured. Scale smears were taken from coho salmon smolts for later age analysis. Environmental data including river level, water temperature

and general weather conditions were recorded daily. Detailed Cleveland dam discharge data were obtained from the Greater Vancouver Water District.

On six occasions, a group of 250 coho salmon smolts from the Capilano Salmon Hatchery were marked with a micro-jet dye and/or fin clip and released into the Cleveland dam spillway. All of these coho salmon smolts were also adipose fin clipped which distinguished them from any other marked fish released upstream. The proportion of marked fish recaptured in the RST was used to estimate the total number of smolts that migrated past the trap site.

UPPER CAPILANO RIVER PRODUCTIVITY ASSESSMENT

In order to assess the productive capacity of the Capilano River upstream of the reservoir several biological parameters were examined. First, coho salmon smolt production was determined by brood year based on age specific population estimates. These values were then combined with information derived from known releases of adult and juvenile coho salmon upstream of the dam and egg to smolt and fry to smolt survival rates were calculated. Since survival to smolt is partially determined by rearing habitat capacity a comparison of observed survival rates with other wild and hatchery stocks allowed for some tentative conclusions to be drawn on the production potential of the upper Capilano River. Also, since the condition coefficient (K value) of smolts can serve as an index of productive capacity (Nikolsky 1963) the K values calculated for smolts from the upper Capilano River were compared with those from other systems to determine the relative condition of smolts. Using this information, inferences were drawn on the ability of the upper Capilano River watershed to support the current levels of fry and adult stocking.

RESULTS AND DISCUSSION

COHO AND STEELHEAD SALMON SMOLT TRAPPING

Fish Capture and Transport

2001 Project: The two rotary screw traps deployed in the upper Capilano River during 2001 were in operation from March 20 to June 13. The trap located at the Lakehead Bridge site was moved across the width of the river between stations (P1 to P3) depending on river flow (Figure 3a). For a total of 67 days, the trap was set in the deepest part of the river (P1) near the left (east) bank. On the remaining 9 days, the trap fished at the P2 location. Damage from debris during periods of high flow put the trap out of commission for a total of 10 days (Appendices 2, 3).

The RST deployed at the reservoir inlet was set in the middle of the channel where flow and depth offered optimal conditions for trap operation. As the level of the reservoir rose, trapping conditions deteriorated and on May 17, the RST was moved upstream to an area of higher flow. On May 31 the trap was moved once again and deployed at the Lakehead Bridge

site for the duration of the program. While fishing at the reservoir inlet site, the trap was out of operation for a total of 12 days. Once located at the Lakehead Bridge, the trap was positioned at the P2 location for 12 days and at P3 for one day (Figure 3a).

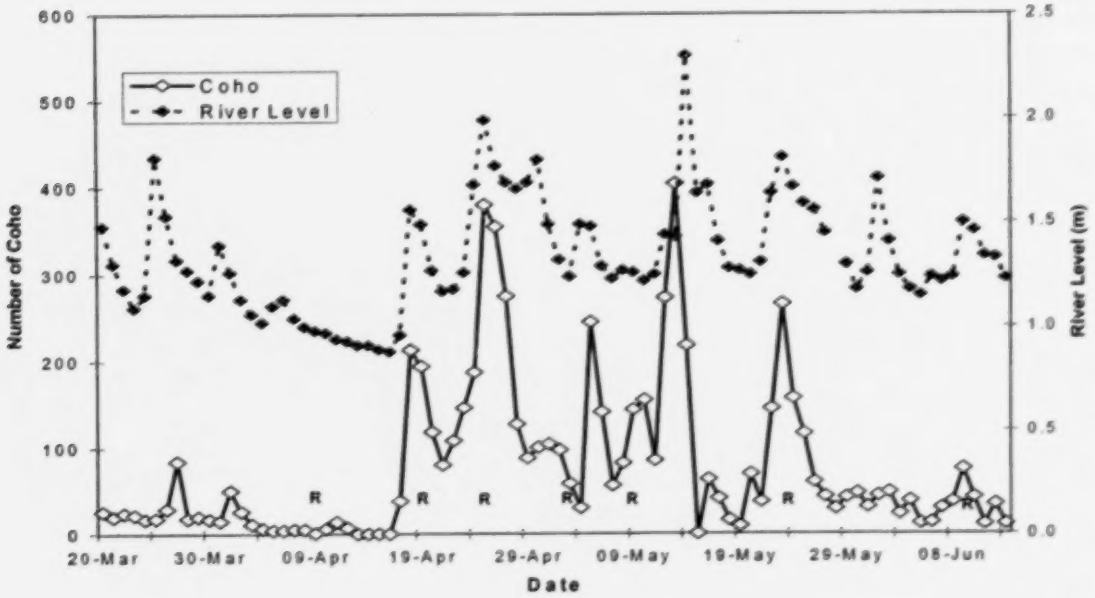

Figure 4. Daily river level and catch of coho salmon smolts in the RSTs deployed in the upper Capilano River in 2001. An "R" indicates a release of marked coho smolts.

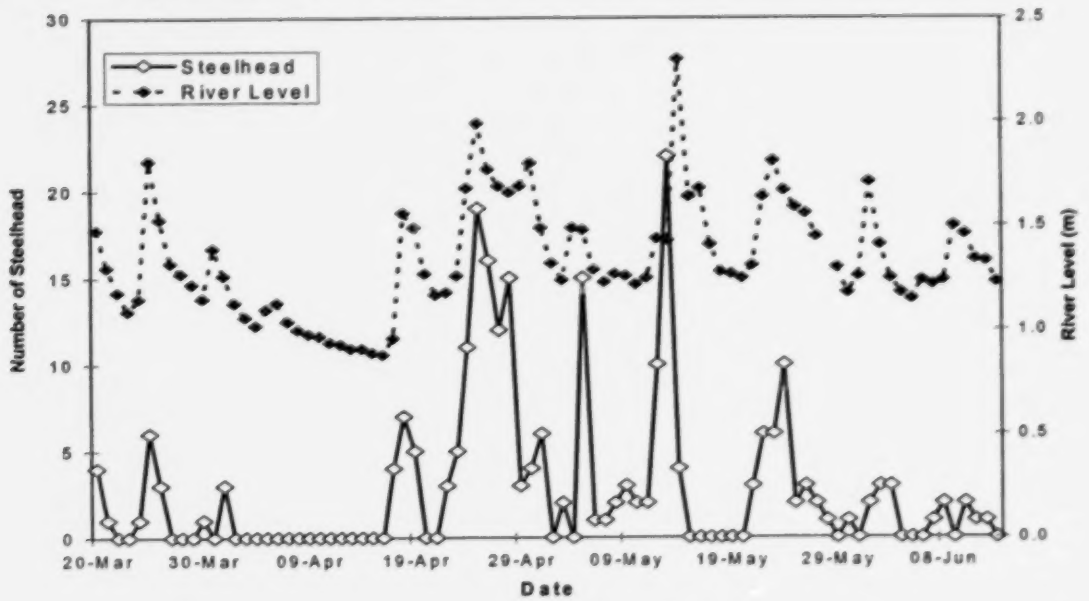

Figure 5. Daily river level and catch of steelhead salmon smolts in the RSTs deployed in the upper Capilano River in 2001.

Coho and steelhead salmon smolts were captured on the first day of trapping indicating that out migration likely began prior to program initiation. While both species continued to be caught when the project was terminated, numbers were very low (Figures 4, 5; Appendices 2, 3). A total of 4,653 coho and 193 steelhead salmon smolts were captured in the traps deployed at the Lakehead Bridge site during 2001 (Table 1). Daily catches of coho salmon smolts ranged from 0 to 278 and averaged 54 fish while steelhead smolt catches ranged from 0 to 16 and averaged 2 fish. The maximum catch of both coho and steelhead salmon smolts occurred on May 13 (Appendices 2, 3). A total of 1,886 coho and 48 steelhead salmon smolts were captured in the RST deployed at the reservoir inlet (Table 1). Daily catches of coho salmon smolts ranged from 0 to 142 and averaged 31 fish while steelhead salmon smolt catches ranged from 0 to 6 and averaged 1 fish. The maximum catch of coho occurred on April 25 while steelhead catch peaked on March 25 and May 13 (Appendices 2, 3). Migration timing, based on total daily catch, is presented in Figures 4 and 5 for coho and steelhead salmon smolts, respectively.

Table 1. Total catch of coho and steelhead salmon smolts, by trap position, in the upper Capilano River in 2001 and 2002.

		Trap Position							
Year	Species	P1	P2	P3	P4	P5	P6	Res. Inlet	Total
2001	Coho	3,512	1,138	3				1,886	6,539
2001	Steelhead	128	64	1				48	241
2002	Coho	7,054	5,604	1,873	1,791	22	1,521		17,865
2002	Steelhead	70	85	18	16	0	29		218

A portion of the coho and steelhead salmon smolts were dead when removed from the trap boxes. Daily mortality rates ranged from 0 to 89.7% and averaged 9.6% (SD ± 17.7%) for coho smolts while steelhead smolt mortality ranged from 0 to 100.0% and averaged 3.6% (SD ± 17.2%) (Appendix 4). Over the duration of the program, a total of 1,137 coho (17.4%) and 5 steelhead (2.1%) salmon smolts were dead when removed from the trap boxes. Mortality appeared dependent on river flow and the related turbulence created in the holding box. Modifications made to the holding box baffling system reduced mortality in the later portions of the study.

In 2001, a total of 4,821 coho and 236 steelhead salmon smolts were transported from the trapping site to the release location downstream of the Cleveland dam. These values represent the total trap catches minus any mortalities and all coho smolts used in the mark recapture study that were not recovered.

2002 Project: The rotary screw traps deployed in the upper Capilano River during 2002 were in operation from March 20 to June 13. All traps were located at the Lakehead Bridge site. The number of traps fishing each day ranged from one to four. Traps were moved between six stations (P1 to P6) depending on river flow (Figure 3b). Extremely low flows seriously impacted trap operation at the start of the program (March 20 – 23), while extremely high flows prohibited fishing from April 12 to April 15.

No coho or steelhead salmon smolts were captured at the start of trapping indicating that out migration likely began during the sampling program. While both species continued to be caught when the project was terminated, numbers were very low (Figures 6, 7; Appendices 5, 6). A total of 17,865 coho and 218 steelhead salmon smolts were captured in the traps deployed in the upper Capilano River during 2002 (Table 1). Daily catches of coho smolts ranged from 0 to 1,296 and averaged 218 fish while steelhead catches ranged from 0 to 19 and averaged 3 fish. The maximum catch of both coho and steelhead salmon smolts occurred on May 13 (Appendices 5, 6). Migration timing, based on total daily catch, is presented in Figures 6 and 7 for coho and steelhead salmon smolts, respectively.

A portion of the coho and steelhead salmon smolts captured were dead when removed from the trap boxes. Daily mortality rates ranged from 0 to 43.4% and averaged 1.1% (SD ± 5.1%) for coho smolts while steelhead smolt mortality ranged from 0 to 15.4% and averaged 0.4% (SD ± 2.2%) (Appendix 7). Over the duration of the program, a total of 213 coho smolts (1.2%) and 3 steelhead smolts (1.4%) were dead when removed from the trap boxes. Modifications made to the holding box baffling system greatly reduced mortality when compared to the 2001 study (Appendix 1).

In 2002, a total of 16,971 coho and 215 steelhead salmon smolts were transported from the trapping site to the release location downstream of the Cleveland dam. These values represent the total trap catches minus any mortalities and all coho smolts used in the mark recapture study that were not recovered.

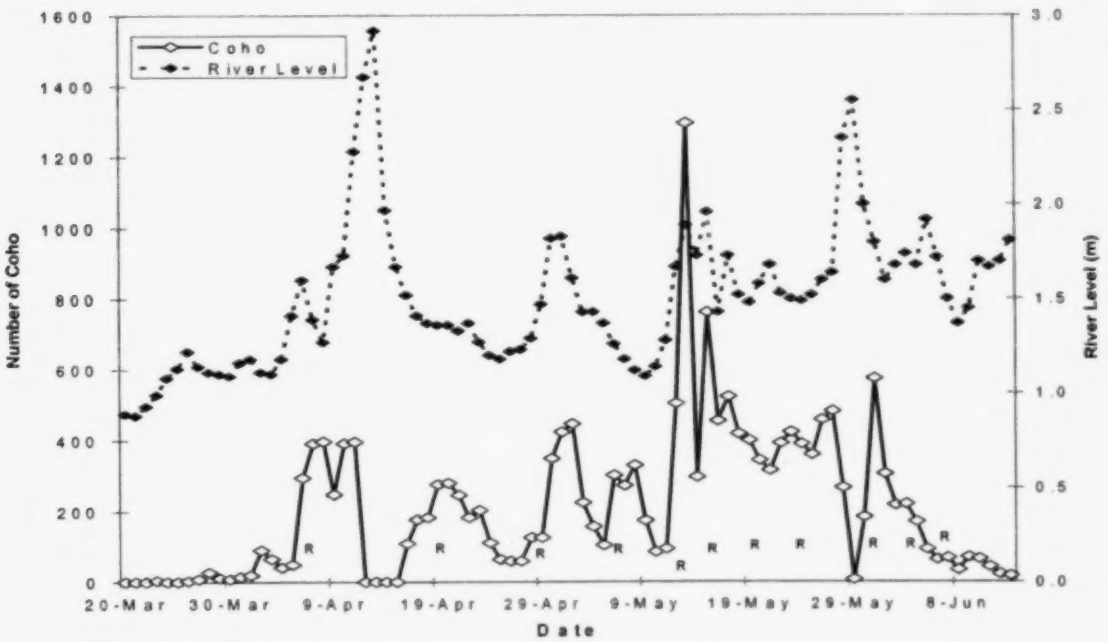

Figure 6. Daily river level and catch of coho salmon smolts in the RSTs deployed in the upper Capilano River in 2002. An "R" indicates a release of marked coho smolts.

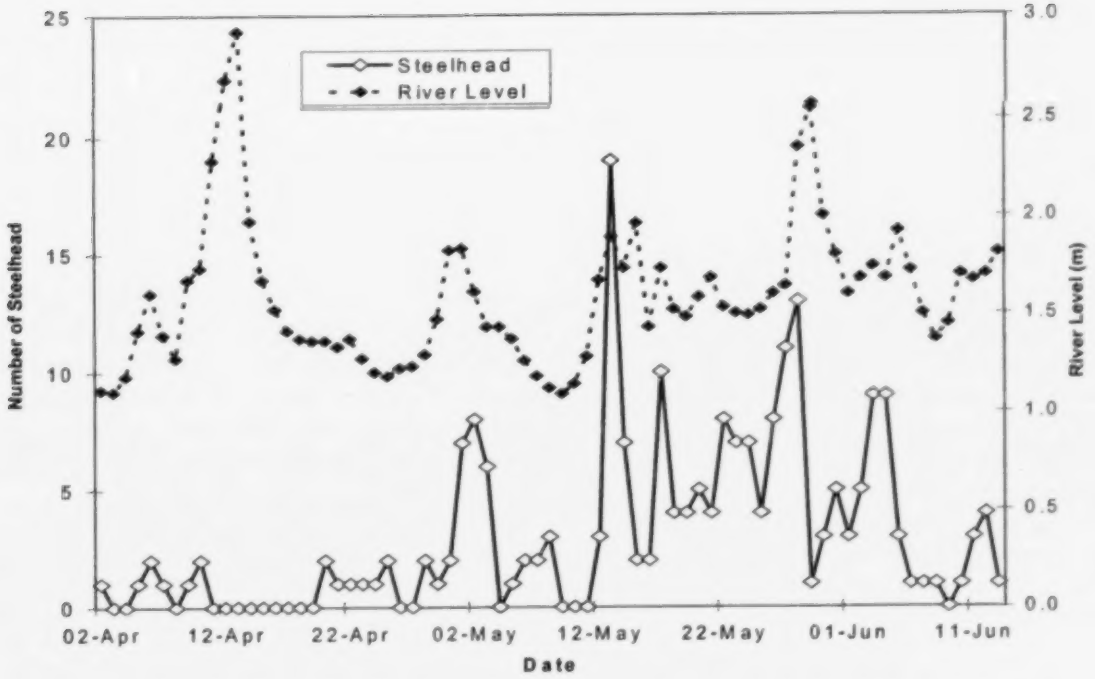

Figure 7. Daily river level and catch of steelhead salmon smolts in the RSTs deployed in the upper Capilano River in 2002.

Environmental Sampling

Conditions in the upper Capilano River during the spring are heavily influenced by runoff due to rain and snowmelt. During the 2001 program, upper Capilano River water temperatures ranged from 2.4 to 9.2 ^{0}C and averaged 5.8 ^{0}C (Appendix 8). Water temperature exhibited a discontinuous increase over the course of the study with the minimum value recorded on April 5 and the maximum on May 31 (Figure 8). River level varied considerably throughout the study with no clear temporal pattern (Figure 8). River level measured at the Lakehead Bridge recording station ranged from 0.88 to 2.30 m and averaged 1.34 m (Appendix 8). River discharge volume was also measured and ranged from 4.22 to 66.29 $m^3 \cdot s^{-1}$ and averaged 23.34 $m^3 \cdot s^{-1}$ (Appendix 8).

During the 2002 program, upper Capilano River water temperatures ranged from 1.4 to 7.6 ^{0}C and averaged 4.4 ^{0}C (Appendix 8). As in 2001, water temperature exhibited a discontinuous increase over the course of the study with the minimum value recorded on March 20 and the maximum on June 13 (Figure 9). Variation in river level was even greater in the 2002 study but again no clear temporal pattern was evident (Figure 9). Average daily river level, measured at the Lakehead Bridge recording station, ranged from 0.88 to 2.74 m and averaged 1.47 m (Appendix 8). River discharge volume was also measured in 2002 and ranged from 4.24 to 168.29 $m^3 \cdot s^{-1}$ and averaged 29.11 $m^3 \cdot s^{-1}$ (Appendix 8).

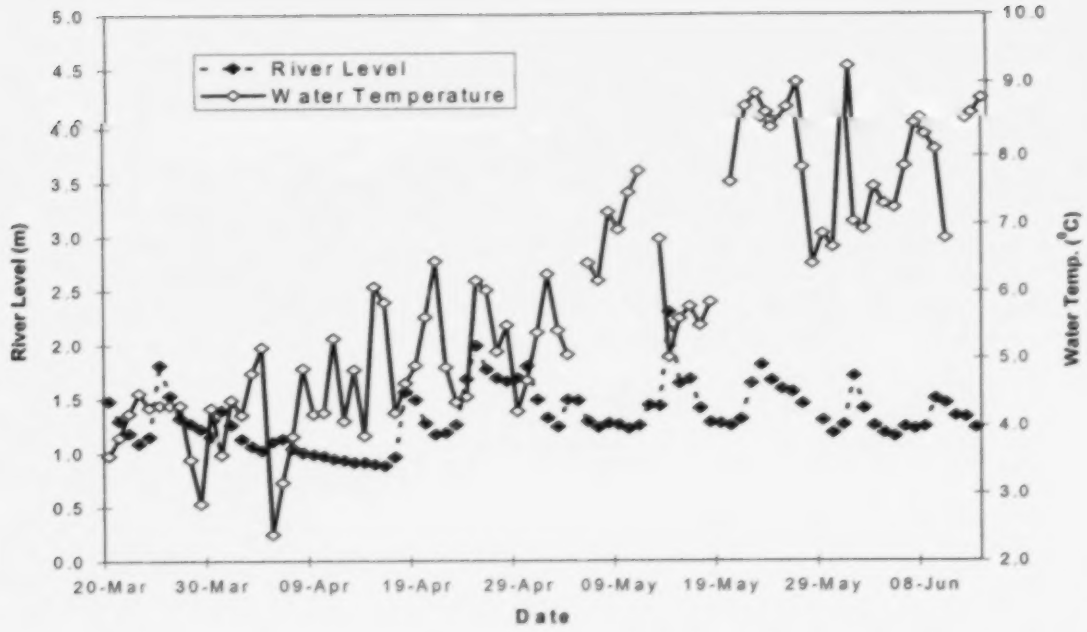

Figure 8. Daily river level and water temperature at the Lakehead Bridge trapping site in the upper Capilano River in 2001.

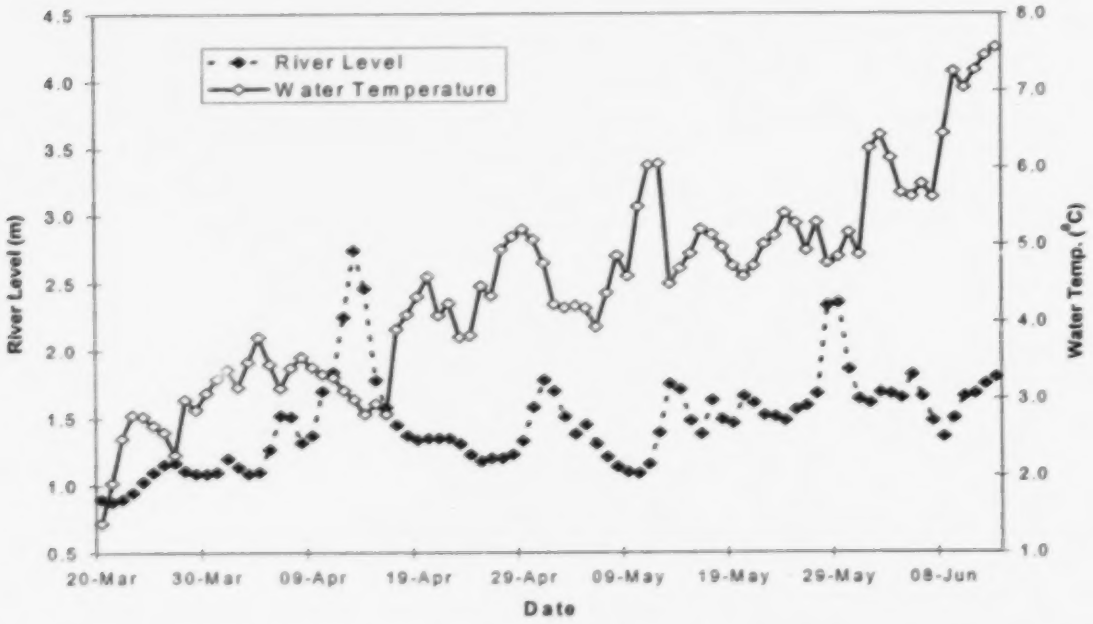

Figure 9. Daily river level and water temperature at the Lakehead Bridge trapping site in the upper Capilano River in 2002.

Biological Sampling

Length and weight data were collected from a total of 265 coho and 45 steelhead salmon smolts over the duration of the 2001 study. Coho smolt nose-fork length (NFL) ranged from 60 to 160 mm and averaged 87 mm (SD ± 14.0 mm) while steelhead smolt NFL ranged from 133 to 204 mm and averaged 162 mm (SD ± 15.0 mm) (Appendix 9). Coho smolt NFL was significantly different between sampling periods (ANOVA: $F = 26.216$; $P < 0.001$) with smolts becoming larger over the duration of the study (Table 2, Figure 10). Steelhead smolt NFL did not exhibit the same pattern and reached a maximum during the second sampling period then declined and remained stable to the end of the study (Table 2, Figure 11).

Length and weight data were collected from a total of 366 coho and 57 steelhead salmon smolts over the duration of the 2002 study. Coho smolt nose-fork length (NFL) ranged from 58 to 152 mm and averaged 82 mm (SD ± 14.7 mm) while steelhead smolt length ranged from 115 to 240 mm and averaged 163 mm (SD ± 18.4 mm) (Appendix 10). Once again coho smolt length was significantly different between sampling periods (ANOVA: $F = 24.448$; $P < 0.001$) with smolts becoming larger over the duration of the study (Table 3, Figure 10). Steelhead NFL reached a maximum in the first sampling period and then varied with no clear trend to the end of the program (Table 3, Figure 11).

Table 2. Average nose-fork length (NFL), weight and condition factor (K value), along with standard deviation (SD) in brackets, by sample date, for coho and steelhead salmon smolts captured in the upper Capilano River in 2001.

Species	Date	n	NFL (mm) Average (SD)	Weight (g) Average (SD)	K Value Average (SD)
Coho	Apr. 17	29	78 (9.3)	5.03 (2.01)	1.030 (0.073)
	Apr. 20	22	73 (5.4)	3.69 (0.85)	0.919 (0.050)
	Apr. 28	29	79 (10.0)	5.12 (2.04)	1.006 (0.066)
	May 5	25	82 (9.9)	6.08 (2.31)	1.071 (0.045)
	May 12	28	83 (9.6)	5.90 (2.11)	1.004 (0.103)
	May 20	61	93 (14.6)	8.72 (5.08)	1.008 (0.056)
	May 29	38	96 (9.5)	9.46 (2.63)	1.051 (0.046)
	Jun. 12	33	101 (10.7)	10.92 (3.32)	1.035 (0.061)
	Overall	265	87 (14.0)	7.34 (3.92)	1.018 (0.073)
Steelhead	Apr. 17	3	161 (13.7)	36.57 (7.18)	0.868 (0.070)
	Apr. 28	14	167 (20.3)	41.79 (14.6)	0.862 (0.066)
	May. 5	14	160 (11.0)	36.63 (7.68)	0.892 (0.054)
	May. 12	10	160 (15.0)	37.06 (10.3)	0.900 (0.198)
	May. 20	4	161 (2.1)	36.56 (2.42)	0.872 (0.045)
	Overall	45	162 (15.0)	38.32 (10.5)	0.881 (0.104)

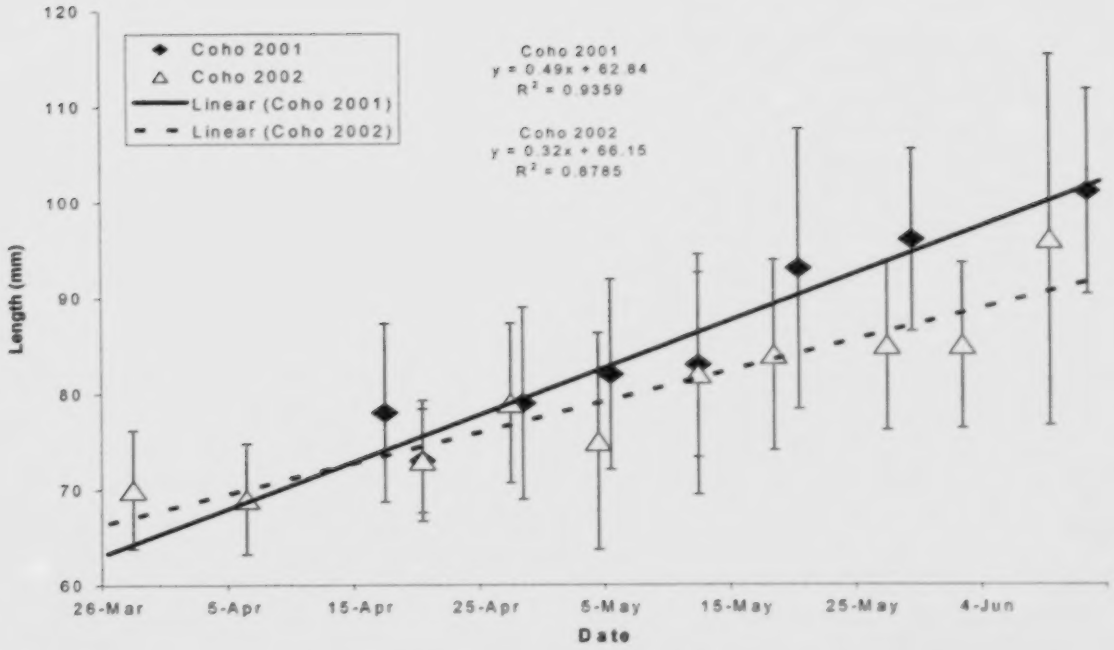

Figure 10. Average nose-fork length, by sampling date, for coho salmon smolts captured in the upper Capilano River in 2001 and 2002. Bars equal ± one standard deviation. Linear regression lines are shown.

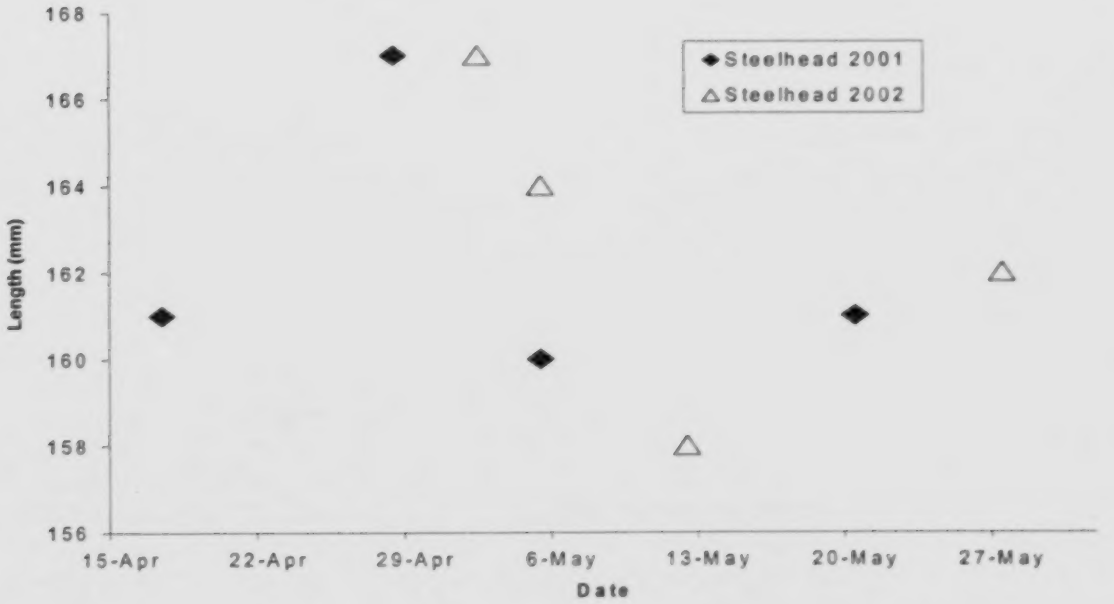

Figure 11. Average nose-fork length, by sampling date, for steelhead salmon smolts captured in the upper Capilano River in 2001 and 2002.

Table 3. Average nose-fork length (NFL), weight and condition coefficient (K value), along with standard deviation (SD) in brackets, by sample date, for coho and steelhead salmon smolts captured in the upper Capilano River in 2002.

Species	Date	n	NFL (mm) Average (SD)	Weight (g) Average (SD)	K Value Average (SD)
Coho	Mar. 28	28	70 (6.2)	3.65 (0.92)	1.033 (0.058)
	Apr. 06	42	69 (5.8)	3.12 (0.73)	0.935 (0.049)
	Apr. 20	27	73 (6.3)	3.72 (0.99)	0.939 (0.045)
	Apr. 27	27	79 (8.3)	4.97 (1.64)	0.988 (0.053)
	May 04	33	75 (11.3)	4.34 (2.35)	0.958 (0.044)
	May 12	33	82 (12.5)	5.61 (2.74)	0.942 (0.059)
	May 18	36	84 (9.9)	6.02 (2.03)	0.993 (0.069)
	May 27	36	85 (8.8)	6.14 (1.91)	0.974 (0.051)
	Jun. 2	34	85 (8.6)	6.43 (1.88)	1.008 (0.056)
	Jun. 9	70	96 (19.3)	9.32 (5.31)	0.969 (0.081)
	Overall	366	82 (14.7)	5.75 (3.48)	0.972 (0.066)
Steelhead	May 1 to 3	21	167 (23.2)	43.90 (22.82)	0.881 (0.062)
	May 5 to 6	3	164 (3.1)	39.17 (3.00)	0.882 (0.049)
	May 12	22	158 (17.0)	35.21 (11.60)	0.858 (0.038)
	May 27	11	162 (10.8)	36.46 (7.65)	0.850 (0.044)
	Overall	57	163 (18.4)	38.86 (16.22)	0.866 (0.050)

Condition coefficients (K values) were calculated for all coho and steelhead salmon smolts that were measured and weighed during both years of the program. In 2001, coho smolt condition coefficients ranged from 0.820 to 1.371 and averaged 1.018 (SD ± 0.073) while steelhead values ranged from 0.749 to 1.448 and averaged 0.881 (SD ± 0.104) (Table 2; Appendix 9). In the 2002 study, coho smolt condition coefficients ranged from 0.807 to 1.171 and averaged 0.972 (SD ± .0.066) while steelhead values ranged from 0.782 to 1.054 and averaged 0.866 (SD ± .0.050) (Table 3; Appendix 10). There was a statistically significant difference in the K value of coho smolts between years (Student's t-test: $t=7.430$; $P<0.001$).

A total of 101 coho salmon smolts captured in the upper Capilano River during 2001 were aged by scale analysis. Scale samples were collected throughout the study period. The majority (85.1%) were aged as 1.0 (brood year 1999) with the remainder aged as 2.0 (brood year 1998) (Table 4). The age notation above follows the European format with number of winters spent in freshwater as a juvenile, followed by the number of winters spent in saltwater as an adult (a fish aged as 1.0 would corresponds to a Gilbert-Rich format of 2_2). A total of 31 coho salmon smolts captured in the upper Capilano River during 2002 were aged by scale analysis. Unlike 2001, scale samples were not collected throughout the study period. The majority (77.4%) were aged as 1.0 (brood year 2000) with the remainder aged as 2.0 (brood year 1999) (Table 4). There

was no statistically significant difference in age composition between years (Yates corrected Chi-square = 0.865; $P > 0.05$).

Table 4. Ages, based on scale analysis, of coho salmon smolts captured in the upper Capilano River in 2001 and 2002.

Age		2001 [1]		2002 [2]		Total	
G. Rich	Euro.	n	%	n	%	n	%
2_2	1.0	86	85.1	24	77.4	110	83.3
3_3	2.0	15	14.9	7	22.6	22	16.7
Total		101	100.0	31	100.0	132	100.0

[1] Scale samples collected during 2 periods: April 29 to May 2 and May 2 to June 12.
[2] All scale samples collected on May 25.

Population Estimates

A portion of the coho salmon smolts captured during each year of the program were marked and released back into the river upstream of the traps. The proportion of marked fish recaptured at the trapping site was used to estimate the total number of smolts migrating downstream. During 2001, a total of 89 marked coho salmon smolts were recovered out of a release of 670 marked fish, yielding a recovery rate, or overall trap efficiency, of 13.3% (Table 5; Appendix 11). During 2002, the recovery rate increased substantially as 400 marked coho smolts were recovered from a total release of 1,081 marked fish, yielding an overall recovery rate of 37.0% (Table 5; Appendix 12).

Table 5. Marked releases, unmarked catch and marks recaptured of coho salmon smolts in the upper Capilano River in 2001 and 2002.

Year	Marked Smolts Released	Marked Smolts Recaptured	Unmarked Smolt Catch	Marked Smolt Recovery Rate (%)	Marked Smolt Incidence (%)
2001	670	89	6,539	13.3	1.3
2002	1,081	400	17,865	37.0	2.2

In 2001, there were two recovery locations: Lakehead bridge site and the reservoir inlet site. In order to determine if there was a spatial bias in the application sample, the mark incidence in the recovery sample at each site was calculated (Table 6). While a bias was detected, it was decided that the data from both sites would be combined and used since this would provide a larger sample size and ultimately, because it was not possible to determine which recovery site was biased.

Table 6. Incidence of marked coho salmon smolts recaptured, by trapping site, in the RSTs deployed in the upper Capilano River in 2001.

Trap Location	Marked Smolts Recaptured	Unmarked Smolt Catch	Marked Smolt Incidence (%)
Lakehead Bridge	76	4,653	1.6
Reservoir Inlet	13	1,886	0.7
Total	89	6,539	1.3
Chi-Square Test Result (Yates corrected):			8.02
Critical Chi-Square (P = 0.05):			3.84

A total of seven trap efficiency trials were carried out in the 2001 study (Appendix 11). In order to generate period specific abundance estimates each efficiency trial must corresponded to one discrete capture period or stratum (i.e. marked releases associated with a specific efficiency trial must all be recovered or migrate past the trap site before the next efficiency trial begins). Since this was not the case for all mark release groups, several strata had to be combined resulting in four separate capture efficiency trials. An assessment of temporal bias in the recovery sample was conducted by comparing the proportion of each marked release group that was recovered (Table 7). The detected bias indicated that the stratified mark recapture design was an appropriate method for estimating the total population of coho salmon smolts migrating downstream out of the upper Capilano River. Period specific capture efficiencies ranged from a low of 9.1 % in the first sampling period to a high of 21.0 % in the second stratum (Table 7). The total estimated out migration of coho salmon smolts from the upper Capilano River in 2001 was 55,318 with 95 % upper and lower confidence limits of 68,700 and 41,937, respectively (Table 8).

Table 7. Proportion of marked coho salmon smolts recaptured, by period, in the RSTs deployed in the upper Capilano River in 2001.

Period	Marked Smolts Released	Marked Smolts Recaptured	Marked Smolt Recovery Rate (%)
Mar. 20 to May 9	374	34	9.1
May 10 to May 22	100	21	21.0
May 23 to Jun. 9	100	15	15.0
Jun. 10 to Jun. 13	96	19	19.8
Total	670	89	13.3
Chi-Square Test Result:			14.66
Critical Chi-Square (P = 0.05):			7.82

Table 8. Stratified population estimates for coho salmon smolts emigrating from the upper Capilano River in 2001.

Period	Marked Smolts Released	Marked Smolts Recaptured	Unmarked Smolt Catch	Period Estimate	Period Variance	95% CL Upper	95% CL Lower
Mar. 20 to May 9	374	34	3,815	40,875	42464583		
May 10 to May 22	100	21	1,515	6,955	1669021		
May 23 to Jun. 9	100	15	1,111	7,013	2469957		
Jun. 10 to Jun. 13	96	19	98	475	10282		
Total				55,318	46613844	68,700	41,937

During the 2002 study, 6 trapping positions were established at the Lakehead Bridge site (Figure 3b). A comparison of mark incidence in the recovery sample from each trap position revealed no significant spatial bias (Table 9). As a result, the data from all traps were combined. A total of 11 trap efficiency trials were carried out in the 2002 study (Appendix 12). Two of the strata had to be combined due to overlapping capture periods. An assessment of temporal bias in the recovery sample indicated no significant bias between the resulting 10 periods (Table 10). Capture efficiencies ranged from a low of 29.5% in the second sampling period to a high of 44.9% in the eighth stratum (Table 10). The total estimated out migration of coho salmon smolts from the upper Capilano River in 2002 was 47,448 with 95% upper and lower confidence limits of 51,386 and 43,509, respectively (Table 11).

Table 9. Incidence of marked coho salmon smolts recaptured, by trapping position, in the RSTs deployed at the Lakehead Bridge site in the upper Capilano River in 2002.

Trap Position	Marked Smolts Recaptured	Unmarked Smolt Catch	Marked Smolt Incidence (%)
P1	160	7,054	2.2
P2	126	5,604	2.2
P3	32	1,873	1.7
P4	39	1,791	2.1
P5	0	22	0.0
P6	43	1,521	2.7
Total	400	17,865	2.2
Chi-Square Test Result:			5.15
Critical Chi-Square (P = 0.05):			11.07

Table 10. Proportion of marked coho salmon smolts recaptured, by period, in all of the RSTs deployed in the upper Capilano River in 2002.

Period	Marked Smolts Released	Marked Smolts Recaptured	Marked Smolt Recovery Rate (%)
Mar. 20 to Apr. 19	110	40	36.4
Apr. 20 to Apr. 28	105	31	29.5
Apr. 29 to May 4	124	39	31.5
May 5 to May 11	105	34	32.4
May 12 to May 14	97	37	38.1
May 15 to May 18	100	41	41.0
May 19 to May 30	190	79	41.6
May 31 to Jun. 3	98	44	44.9
Jun. 4 to Jun. 6	89	28	31.5
Jun. 7 to Jun. 13	63	27	42.9
Total		400	37.0
Chi-Square Test Result:			12.31
Critical Chi-Square (P = 0.05):			16.92

Table 11. Stratified population estimates for coho salmon smolts emigrating from the upper Capilano River in 2002.

Period	Marked Smolts Released	Marked Smolts Recaptured	Unmarked Smolt Catch	Period Estimate	Period Variance	95% C.L. Upper	95% C.L. Lower
Mar. 20 to Apr. 19	110	40	3,202	8,669	1142805		
Apr. 20 to Apr. 28	105	31	1,331	4,409	421112		
Apr. 29 to May 4	124	39	1,726	5,394	493693		
May 5 to May 11	105	34	1,362	4,125	324713		
May 12 to May 14	97	37	2,097	5,408	467457		
May 15 to May 18	100	41	2,158	5,189	372976		
May 19 to May 30	190	79	4,023	9,605	675061		
May 31 to Jun. 3	98	44	1,319	2,902	103254		
Jun. 4 to Jun. 6	89	28	328	1,018	25480		
Jun. 7 to Jun. 13	63	27	319	729	11217		
Total				47,448	4037767	51,386	43,509

Project Assessment and Recommendations

The successful capture and transport of coho and steelhead salmon smolts past the Cleveland dam on the Capilano River during 2001 and 2002 indicates the feasibility and value of

such a project. Over the two years of the program, a total of 21,792 coho salmon smolts that reared in the upper Capilano River upstream of the reservoir were trapped and moved past the dam. The value of the resulting adult coho salmon production to local recreational and First Nation's fisheries is substantial.

The increased number of coho salmon smolts captured during the second year of the project was partially due to the deployment of more traps but also reflects the implementation of the important lessons learned during the first year of trapping. As an example, the improved baffling system installed in the trap boxes during 2002 greatly reduced mortalities resulting in the successful transport of more smolts past the dam. Any future programs will continue to benefit from the experience gained during both the 2001 and 2002 trapping studies.

The condition coefficient (K value) of juvenile salmonids has been used to describe the overall health of smolts based on body shape. It has often been used to compare the status of smolts between geographic locations with larger values associated with better general condition (Nikolsky 1963). Average condition coefficients calculated for coho salmon smolts from the upper Capilano River were 1.018 (SD ± 0.073) and 0.972 (SD ± 0.066) for the 2001 and 2002 studies, respectively. McHenry (1977) reported an average K value of 0.98 for coho smolts from Bear Creek, Alaska and considered this condition coefficient to be excellent. During 1981 and 1982, two time and size at release studies conducted at the Capilano Salmon Hatchery reported average K values of 1.133 and 1.116 for coho smolts across all release groups (Bilton *et al.* 1982, 1983). Shepherd *et al.* (1986) reported an average K value of 1.038 for coho salmon collected from 7 streams on the south coast of British Columbia. In sampling conducted on the Quinsam River, British Columbia, during 2002, coho smolt K values ranged from 0.68 to 1.10 and averaged 0.91 (Dave Ewart, Fisheries and Oceans Canada, Quinsam River Hatchery, BC, pers. comm.). This review of reported coho salmon smolt condition coefficients from both hatchery and wild stocks along the coast indicates that coho smolts from the upper Capilano system compare well with those from other systems and suggests a generally high level of smolt health.

Most projects of this type require at least one full season of development before final implementation (Carlson *et al.* 1998). The lessons learned from the 2001 study greatly benefited the 2002 project. The most significant concern associated with the 2001 study was the lack of discreteness between trap efficiency trials. On many occasions, marked fish were recovered in two subsequent strata requiring the combining of several sampling periods. As a result, separate estimates of abundance could not be generated for periods that exhibited significantly different trap efficiencies. The presence of such bias created some uncertainty around the final population estimate. This issue was addressed appropriately in the 2002 study as marked fish were recovered across two strata in only one of 11 trap efficiency trials. Awareness of this study design requirement is vital in any future projects.

The performance of all sampling gear varies under different environmental conditions. The capture efficiency of rotary screw traps is largely dependent on river flow dynamics. As a result, it is critical to ensure that efficiency trials are conducted under all flow regimes. Table 12 presents a breakdown of the 2002 mark releases by 8 river level ranges along with the number of days in the range and the number of coho salmon smolts captured. While most of the common

conditions are well represented, as well as those producing most of the catch, both the extreme low and high river levels did not have an associated mark release group. Both river conditions are important. The lowest level range represented 17.4% of the total study period. While it is understood that the traps did not fish well under low flows, a total of 802 coho smolts (4.5% of the total coho smolt catch) were captured under these conditions. The three highest river level ranges listed in Table 12 did not have associated marked releases. While these extreme conditions represented only five days in the study period it is important to know what the trapping efficiencies were at these flows since peak smolt out-migration often coincides with maximum stream discharge (Sandercock 1991). It is recommended that future projects ensure that releases of marked fish occur under all flow conditions including the lowest and highest river levels when traps may not operate optimally.

Table 12. Number of days and marked release groups and coho salmon smolts captured, stratified by river level range, in the upper Capilano River in 2002.

River Level Range (m)	Days in River Level Range		Number of Marked Smolt Release Groups	Unmarked Smolt Catch	
	n	%		n	%
0.88 to 1.15	15	17.4	0	802	4.5
1.16 to 1.42	24	27.9	3	3,688	20.6
1.43 to 1.69	26	30.2	4	7,424	41.6
1.70 to 1.98	15	17.4	3	5,097	28.5
1.99 to 2.25	1	1.2	1	184	1.0
2.26 to 2.52	2	2.3	0	663	3.7
2.53 to 2.79	2	2.3	0	7	0.0
2.80 to 3.08	1	1.2	0	0	0.0
Total	86	100.0	11	17,865	100.0

In 2002, the first release of marked coho salmon smolts did not occur until April 6 (Figure 6; Appendix 12). This was 18 days into the trapping program and the resulting measure of trap efficiency represented a full month of captures. It is recommended that a release of marked fish occur at the start of the study to ensure that one measure of trap efficiency is not applied over such a long period of sampling. Since daily catches may be low during this period, it is likely that fish will need to be held over several days or supplemented with appropriate sized hatchery smolts in order to compile an appropriate mark release group.

An appropriately implemented temporally stratified mark recapture study likely captures the effect of many environmental parameters on trap efficiency; however, it would also be interesting and informative to pursue additional analytical approaches in future studies. These could include determining trap efficiency based on specific environmental or biological parameters such as water level, turbidity or fish size and applying these values to the appropriate segments of smolt out-migration.

It is important to measure the short-term survival of fish after marking as well as the rate of mark retention for smolts in each stratum (Carlson *et al.* 1998). This ensures that a positive bias in the population estimate does not occur due to unassessed mortality of marked smolts or due to the loss of the marks applied. To accomplish this, a sample of marked smolts should be held for one to two days and then checked for mark retention and survival. Adjustments to the strata estimates can then be made based on the estimated number of marked fish that were available for capture. In any mark recapture study it is important that the marked group be representative of the unmarked population in order to achieve an unbiased estimate. To test this assumption biological data, including length, weight and age, must be collected from smolts making up the marked group.

During the 2002 study, all scale samples were collected from smolts on a single day and it is unknown if the resulting age composition was representative of the entire smolt population. In this study, it was shown that NFL in coho salmon smolts varied over time (Figure 10). Since length is correlated with age, it follows that a sample collected at a single point during the program runs the risk of not representing the entire population. It is recommended that the collection of scales occurs regularly throughout the trapping program and that length and weight data also be collected from scaled fish so that ages can be matched to biological data. With this additional information, production estimates can be made by age class and therefore associated with the appropriate brood year.

SPILLWAY PASSAGE SURVIVAL RATE

Fish Capture

In 2001, a single RST was deployed in the lower Capilano River immediately downstream of the Cleveland dam spillway (Figure 2). This trap was in position from March 21 to June 14 but was only operational beginning on April 18. The limited flow that existed in the lower river during periods of low reservoir discharge greatly hampered trap operation.

A total of 2,537 coho and 26 steelhead salmon smolts were captured in the RST deployed in the lower Capilano River below the dam spillway (Table 13). Daily catches of coho smolts ranged from 0 to 599 and averaged 44 fish while steelhead smolt catches ranged from 0 to 4 fish. The maximum catch of both coho and steelhead salmon smolts occurred on May 16 (Appendices 13, 14). Migration timing, based on daily coho smolt catch, is presented in Figure 12. Steelhead smolt catches were too low to chart.

Each smolt captured in the RST was assigned a condition code ranging from A (excellent) to E (dead). Daily catches, by condition code, are presented in Appendices 13 and 14 for coho and steelhead salmon smolts, respectively. A total of 56.2% of all coho smolts captured were assigned an E condition code (1,427 fish). The rest of the coho smolt catch was fairly evenly distributed among the remaining 4 condition codes (Appendix 13). A total of 42.3% of all steelhead captured were assigned a B code (satisfactory) while 19.2 % were dead when sampled (Appendix 14).

Table 13. Monthly summary of the total catch of category I and II coho and steelhead salmon smolts, with average spillway discharge, in the Capilano River below Cleveland dam in 2001.

Month	Average Spillway Discharge (cfs)	Coho [1]				Steelhead			
		Category I		Category II		Category I		Category II	
		n	%	n	%	n	%	n	%
April	673	74	37.6	123	62.4	5	83.3	1	16.7
May	503	465	21.7	1,680	78.3	8	53.3	7	46.7
June	124	52	26.9	141	73.1	3	60.0	2	40.0
Total		591	23.3	1,944	76.7	16	61.5	10	38.5

[1] totals do not include data associated with 2 coho smolts captured in March.

Notes: Category I = condition codes A and B. Category II = condition codes C, D and E

Monthly catches of coho and steelhead salmon smolts were grouped into two categories. Category I consisted of fish in condition codes A and B and was defined as those fish that were expected to survive. Category II consisted of fish in condition codes C, D and E and was defined as those fish that were not expected to survive or were dead when sampled. While it may be argued that a portion of the condition code C fish will survive, the sublethal effects of stress on juvenile salmonids has been shown to be extremely detrimental to long term survival (Mesa *et al.* 1994, Birtwell *et al.* 2001). Using this method, a total of 76.7% of all coho and 38.5% of all steelhead salmon smolts captured in the lower Capilano River RST were in category II. The percentage of category II coho smolts ranged from 78.3% in May to 62.4% in April while the percentage of category II steelhead ranged from 16.7% in April to 46.7% in May (Table 13).

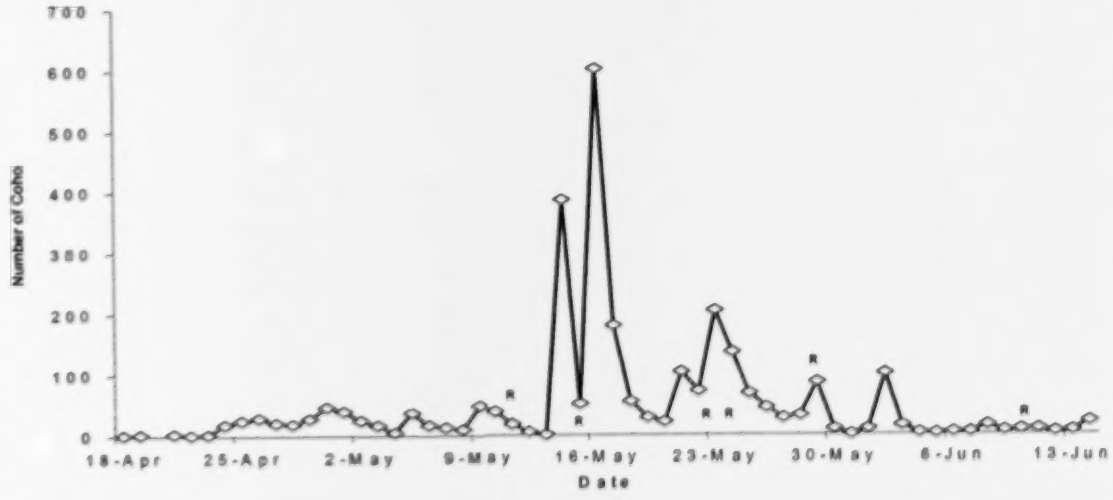

Figure 12. Daily catch of coho salmon smolts in the RST deployed in the lower Capilano River in 2001. An "R" indicates a release of marked coho smolts.

The relationship between spillway discharge and coho salmon smolt condition was examined by stratifying spillway discharge into 100 cfs increments and determining the total number of category I and II coho smolts captured at each discharge level (Table 14). While the highest proportion of category II coho smolts (91.1%) occurred at the highest discharge level (over 1000 cfs), the second highest rate (80.7%) occurred at a very low discharge level (101 to 200 cfs) (Table 14). To further explore this relationship the percentage of category II coho smolts in the daily trap catch was plotted against daily spillway discharge. The resulting regression relationship was positive and statistically significant indicating that when spillway discharge was high, a higher percentage of coho smolts captured in the RST were dead or not expected to survive ($F = 9.482$; $P < 0.05$) (Figure 13). It should be noted that when all condition code C coho smolts were placed in category I the regression relationship was still positive and statistically significant ($F = 12.367$; $P < 0.001$).

Table 14. Proportion of category I and II coho and steelhead salmon smolts captured, stratified by spillway discharge, in the Capilano River below Cleveland dam in 2001.

Spillway Discharge Range (cfs)	Days in Discharge Range	Coho [1]				Steelhead			
		Category I		Category II		Category I		Category II	
		n	%	n	%	n	%	n	%
0 to 100	9	40	54.1	34	45.9	0		0	
101 to 200	10	28	19.3	117	80.7	3	60.0	2	40.0
201 to 300	11	96	33.8	188	66.2	0		0	
301 to 400	4	46	27.5	121	72.5	0		0	
401 to 500	3	16	22.2	56	77.8	1	50.0	1	50.0
501 to 600	3	37	44.6	46	55.4	0		0	
601 to 700	2	28	60.9	18	39.1	0		0	
701 to 800	3	115	25.7	332	74.3	2	40.0	3	60.0
801 to 900	4	34	29.3	82	70.7	2	66.7	1	33.3
901 to 1000	5	76	29.6	181	70.4	4	66.7	2	33.3
Over 1000	4	75	8.9	769	91.1	4	80.0	1	20.0
Total	58	591	23.3	1,944	76.7	16	61.5	10	38.5

[1] totals do not include data associated with 2 coho smolts captured in March.

Notes: Category I = condition codes A and B. Category II = condition codes C, D and E.

Environmental Sampling

Detailed upper Capilano reservoir discharge data, along with several other parameters of the Cleveland dam operation, are presented in Appendix 15. Between April 1 and June 30, spillway flow ranged from 0 to 1,565 cfs and averaged 305 cfs (SD ± 372 cfs). Peak discharge occurred on May 14 while there was no water flowing over the spillway on April 15, April 16 and May 12 (Figure 14).

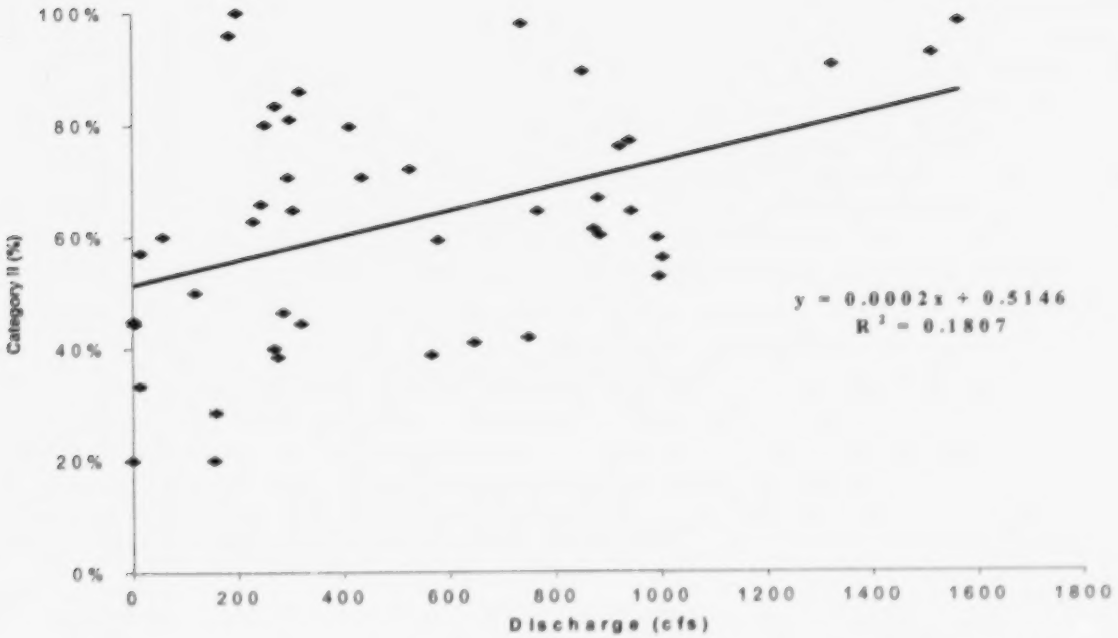

Figure 13. Regression relationship between the daily percentage of category II (dead or not expected to survive) coho salmon smolts captured in the lower Capilano River RST below Cleveland dam and Cleveland dam spillway discharge in 2001.

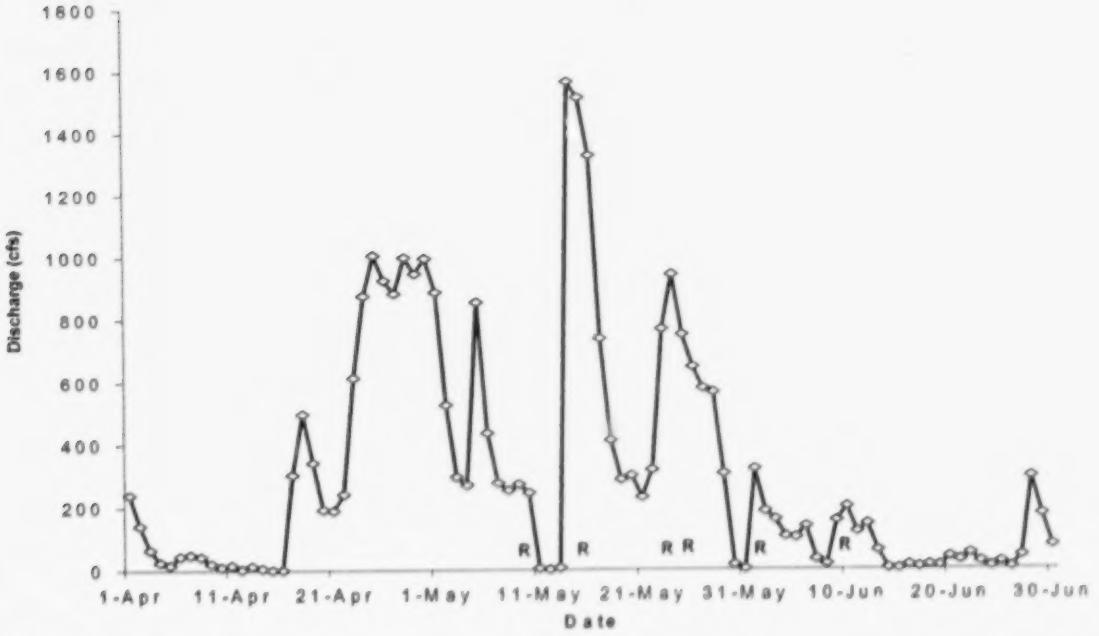

Figure 14. Daily discharge from the Cleveland dam spillway in 2001. An "R" indicates a release of marked coho salmon smolts.

Biological Sampling

A total of 132 coho salmon smolts captured by the RST deployed below the Cleveland dam spillway were sampled for length and weight (Appendix 16). Nose-fork length ranged from 75 to 153 mm and averaged 107 mm (SD ± 16.6 mm) while weight ranged from 4.89 to 37.13 g and averaged 13.31 g (SD ± 5.96 g). Condition coefficients (K values) were calculated for all coho salmon smolts sampled and ranged from 0.745 to 1.280 and averaged 1.040 (SD ± 0.076) (Appendix 16).

A total of 89 coho salmon smolts captured in the lower Capilano River during 2001 were aged by scale analysis. All coho sampled for scales were dead when removed from the trap (condition code E). The majority (83.1%) were aged as 1.0 (brood year 1999) with the remainder aged as 2.0 (brood year 1998) (Table 15). When the age data were stratified into groups that were less than or greater than 110 mm nose-fork length, the larger fish were still dominated by the 1.0 age class (76.2%) but exhibited a higher proportion of age 2.0 fish (Table 15).

Table 15. Ages, by length category, of coho salmon smolts captured in the lower Capilano River below the Cleveland dam spillway in 2001.

Age		Nose-Fork Length Less Than 110 mm		Nose-Fork Length Greater Than 110 mm		Total	
G. Rich	Euro.	n	%	n	%	n	%
2_2	1.0	42	89.4	32	76.2	74	83.1
3_3	2.0	5	10.6	10	23.8	15	16.9
Total		47	100.0	42	100.0	89	100.0

Population Estimate

Six groups of coho salmon smolts from the Capilano Salmon Hatchery were marked and released into the Cleveland dam spillway (Figure 14). The proportion of marked fish recaptured at the lower Capilano River trapping site was used to estimate the total number of smolts migrating past the dam. In 2001, a total of 87 marked coho smolts were recovered out of a release of 1,500 fish, yielding a recovery rate, or overall trap efficiency, of 5.8% (Table 16).

A total of six trap efficiency trials were carried out in the 2001 study. Each efficiency trial corresponded to one downstream capture period or stratum. An assessment of temporal bias in the recovery sample was conducted by comparing the proportion of each marked release group that was recovered (Table 16). A significant bias existed supporting the use of the stratified mark recapture design. Capture efficiencies ranged from a low of 0.4 % in the first sampling period to a high of 12.0 % in the second stratum (Table 16). The total estimated number of coho salmon smolts migrating downstream past the trap site was 106,808 with 95 % upper and lower confidence limits of 200,924 and 12,692, respectively (Table 17).

Table 16. Proportion of marked coho salmon smolts recaptured, by period, in the RST deployed in the lower Capilano River below the Cleveland dam spillway in 2001.

Period	Marked Smolts Released	Marked Smolts Recaptured	Marked Smolt Recovery Rate (%)
Apr. 18 to May 14	250	1	0.4
May 15 to May 22	250	30	12.0
May 23	250	16	6.4
May 24 to May 28	250	21	8.4
May 29 to Jun. 8	250	7	2.8
Jun. 9 to Jun. 14	250	12	4.8
Total	1,500	87	5.8
Chi-Square Test Result:			38.77
Critical Chi-Square (P = 0.05):			11.07

Table 17. Stratified population estimate for coho salmon smolts migrating past the trapping site in the lower Capilano River in 2001.

Period	Marked Smolts Released	Mark Smolts Recaptured	Unmarked Smolt Catch [1]	Period Estimate	Period Variance	95% CL Upper	95% CL Lower
Apr. 18 to May 14	250	1	663	83,207	2296291384		
May 15 to May 22	250	30	1,079	8,736	2150639		
May 23	250	16	202	2,982	499476		
May 24 to May 28	250	21	303	3,457	508466		
May 29 to Jun. 8	250	7	239	7,499	6251041		
Jun. 9 to Jun. 14	250	12	48	927	73928		
Total				106,808	2305774934	200,924	12,692

[1] totals do not include data associated with 2 coho smolts captured in March and 1 coho smolt capture on April 1.

Project Assessment and Recommendations

The capture efficiency of rotary screw traps is greatly reduced at low flows. This property of the sampling gear may have differentially affected the capture rates of live versus dead fish. Since live fish could easily avoid capture when spillway discharge was low it seems likely that the RST recovered a higher proportion of dead fish under these conditions. Conversely, Vernon and Hourston (1957) released marked live and dead coho salmon smolts below the Cleveland dam spillway and found that dead fish were recovered at a rate that was 79% lower than live fish. While the recovery gear used in their study (fyke nets) differed from ours it is clear that live and dead fish can be recovered at different rates. If future studies are anticipated, it is recommended

that additional sampling gears be employed and that a study be implemented to measure and compare the recoverability of live versus dead smolts at varying levels of discharge.

Although the mortality rate for coho salmon smolts captured below the spillway was high (56.2% dead when removed from the trap), the mortality rate for coho smolts captured in the RSTs deployed above the dam in the upper river was also substantial in 2001 (17.4% dead when removed from the traps). A statistical comparison of the mortality rates revealed significantly higher mortality in the RST deployed downstream of the spillway (Yates corrected chi-square = 1352.50; $P < 0.001$). This suggests that along with RST mortality, passage over the spillway significantly contributed to the mortality observed in coho smolts captured downstream of the dam. It is interesting to note the mortality rate for the RST deployed in the upper Capilano River in 2002 was only 1.2% (n = 17,865; Appendix 7). To clarify the issue of spillway induced mortality versus RST (or trap) induced mortality, an extensive analysis of the relationship between river flow, spillway and trapping mortality, and inter-annual variation in mortality should be undertaken.

While there is some uncertainty as to the absolute mortality rate associated with the passage of coho smolts over the spillway, the mortality rate reported in this study is very similar to the value reported for a two year study conducted shortly after dam construction (Vernon and Hourston 1957). During 1955 and 1956, spillway mortality was assessed through the paired releases of smolts into the spillway and into the river immediately below the spillway pool. Over the two years of the project, the mortality rate for coho salmon smolts travelling over the spillway was determined to be 57% (Vernon and Hourston 1957). While this study employed different methods and sampling gear (fyke nets) the consistency of these results with our findings suggests that actual spillway mortality contributes significantly to any observed mortality.

During the 2001 spillway study, all scale samples were collected from dead smolts and the resulting age composition may not been representative of the entire population. To address this situation, it is recommended that the collection of scales occur regularly throughout the trapping program from both live and dead fish. Also, length and weight data should be collected from aged fish and recorded such that all biological information can be linked.

The capture efficiency of rotary screw traps is largely dependent on river flow dynamics and it is therefore critical to ensure that efficiency trials are conducted under all flow regimes. Table 18 presents a breakdown of the 2001 spillway mark releases by 11 discharge level ranges along with the number of days in the range and the number of coho salmon smolts caught. Most of the common conditions are well represented, as well as those producing most of the catch; however, since RSTs perform poorly when water flows are insufficient to produce adequate drum rotation, a low capture efficiency rate (i.e. marked smolt recovery rate) occurred during the first sampling period when spillway discharge was minimal (Table 16). The high variance associated with this stratum resulted in a total population estimate with a very low precision (95% CI ± 88.1%) (Table 17). If a similar project is implemented in the future it may be necessary to employ additional sampling gears that work well under extreme low flow conditions.

Figure 12 indicates that the first release of marked coho salmon smolts did not occur until May 11. This was 24 days into the trapping program and the resulting measure of trap efficiency

represented almost a full month of captures. If future studies are implemented, effort should be made to ensure that one measure of trap efficiency is not applied over such a long period of sampling.

Table 18. Number of days and marked release groups and coho salmon smolts captured, stratified by spillway discharge, in the Capilano River below Cleveland dam in 2001.

Spillway Discharge Range (cfs)	Days in Discharge Range		Number of Marked Smolt Release Groups	Unmarked Smolt Catch [1]	
	n	%		n	%
0 to 100	9	15.5	1	74	2.9
101 to 200	10	17.2	1	145	5.7
201 to 300	11	19.0	0	284	11.2
301 to 400	4	6.9	1	167	6.6
401 to 500	3	5.2	0	72	2.8
501 to 600	3	5.2	0	83	3.3
601 to 700	2	3.4	0	46	1.8
701 to 800	3	5.2	1	447	17.6
801 to 900	4	6.9	0	116	4.6
901 to 1000	5	8.6	1	257	10.1
over 1000	4	6.9	1	844	33.3
Total	58	100.0	6	2,535	100.0

[1] totals do not include data associated with 2 coho smolts captured in March.

One of the critical assumptions underlying any mark recapture study is that marked fish suffer the same mortality as unmarked fish (Ricker 1975). An examination of the proportion of dead (condition E only) fish in the marked (27.6% dead) and unmarked (57.3% dead) trap catch revealed a statistically significant difference (Yates corrected chi-square = 28.91; $P < 0.05$). This result suggests that the marked fish may not have been entirely representative of the unmarked population.

It is important to measure the short-term survival of fish after marking as well as the rate of mark retention for smolts and to adjust the marked release numbers accordingly. Failure to account for these variables may bias the estimate high as recaptured marked fish are not identified as such and mortality of the marked group usually decreases their probability of recapture (Ricker 1975). To accomplish this in future studies, it is recommended that a sample of marked smolts from each release group be held for one to two days and then checked for mark retention and survival. It is also recommended that biological data be collected from smolts making up each mark release group so that testing can be conducted to ensure that these fish are representative of the unmarked population.

UPPER CAPILANO RIVER PRODUCTIVITY ASSESSMENT

Adult coho and steelhead salmon returning to the Capilano River have been captured and transported above the Cleveland dam since 1954 (Appendix 17). This practice allowed returning adults to access historical spawning areas that had been cut off by the dam. The transport of adult salmon did not occur in 1975 or from 1977 to 1996 inclusive, when only juveniles were released into the upper Capilano watershed. Between 1954 and 1974 the number of adult coho salmon transported upstream of the dam ranged from 325 to 5,132 and averaged 2,454. Between 1954 and 1972 the number of adult steelhead salmon transported upstream of the dam ranged from 5 to 214 and averaged 88. Since 1997, adult coho salmon releases into the upper Capilano watershed have ranged from 553 to 4,074 and averaged 2,044 (Appendix 17). Adult steelhead salmon transport was terminated in 1972.

Since 1977, fed and unfed coho and steelhead salmon fry from the Capilano Salmon Hatchery have been released into the upper Capilano River upstream of the Cleveland dam. Annual coho salmon fry releases have ranged from 0 to 836,321 and averaged 230,442 while yearly steelhead releases have ranged from 0 to 136,009 and averaged 29,291 (Appendix 18).

Table 19. Details of all Capilano Salmon Hatchery fry releases into the upper Capilano River for the brood years ranges 1998 to 2000 and 1997 to 2001 for coho and steelhead salmon, respectively.

Brood Year	Species/ Timing	Release Date	Release Stage	Number Released	Size @ Release (g)	Release Site
1998	Coho/NK	Jul.21-Aug.10,1999	Fed Fry	221,707	1.57 - 2.12	Upper Cap. R. & Tribs
1999	Coho/Late	Apr.27, 2000	Unfed Fry	80,601	0.28	Cap. Res. & Tribs
1999	Coho/Late	Jun.30, 2000	Fed Fry	62,059	1.6	Cap. Res.
1999	Coho/Late	Aug.1-Aug.2, 2000	Fed Fry	112,540	1.9 - 2.1	Upper Cap. R. & Tribs
2000	Coho/Late	Jul.10-Jul.26, 2001	Fed Fry	403,659	1.83 - 2.03	Upper Cap. R. & Tribs
1997	Steelhead	Nov.15, 1997	Fed Fry	31,509	3.71	Upper Cap. R. & Tribs
1998	Steelhead	Aug.21, 1998	Fed Fry	46,859	1.53	Upper Cap. R. & Tribs
1999	Steelhead	Dec.2, 1999	Fed Fry	12,607	3.15	Upper Cap. R. & Tribs
2000	Steelhead	Oct.2000	Fed Fry	15,256	3.07	Upper Cap. R. & Tribs
2000	Steelhead	Nov.2000	Fed Fry	7,480	2.98 - 6.08	Upper Cap. R. & Tribs
2001	Steelhead	Aug.23, 2001	Fed Fry	68,543	1.28	Upper Cap. R. & Tribs
2001	Steelhead	Oct.2001	Fed Fry	2,131	3.63	Upper Cap. R. & Tribs

NK = not known

Details of the release of coho and steelhead salmon fry that contributed to the smolt production monitored during the 2001 and 2002 studies are presented in Table 19. Most of the coho salmon juveniles were progeny of adults from the late returning component of the run and were released as fed fry. Annual releases ranged from 221,707 in 1999 to 403,659 in 2001. The average size at release ranged from 0.28 g for a group of unfed fry released in 2000 to 2.12 g for a 1999 release of fed fry (Table 19). Release sites included the upper Capilano River and

tributaries, the Capilano Reservoir, and tributaries to the reservoir. All juvenile steelhead salmon releases were made up of fed fry ranging in size from 1.28 to 6.08 g. Annual steelhead fry releases ranged from 12,607 in 1999 to 70,674 in 2001 with all fry being released into the upper Capilano River and its tributaries (Table 19).

Details of the release of adult coho salmon spawners that contributed to the smolt production monitored during the 2001 and 2002 studies are presented in Table 20. Adult hatchery coho salmon released into the upper Capilano River were from early, mid and late returning components of the run. Total releases ranged from 553 in 1998 to 2,787 in 2000 with all fish released into the river at the Lakehead Bridge site (Figure 2). Egg deposition was estimated using annual fecundity values measured at the Capilano Salmon Hatchery for similar run timing groups. Egg deposition estimates ranged from 247,977 in 1998 to 1,312,822 in 2000 (Table 20).

Table 20. Details of all Capilano Salmon Hatchery adult coho salmon releases into the upper Capilano River for the years 1998 to 2000.

Brood Year	Species/ Timing	Release Date	Number Released	Number of Females	Fecundity	Estimated Egg Deposition	Release Site
1998	Coho/NK	Fall 1998	553	177	1,401	247,977	Lakehead Bridge
1999	Coho/Mid	Fall 1999	916	392	1,322	518,224	Lakehead Bridge
1999	Coho/Late	Fall 1999	688	145	1,990	288,550	Lakehead Bridge
2000	Coho/Early	Fall 2000	615	171	1,212	207,252	Lakehead Bridge
2000	Coho/Mid	Fall 2000	1,740	685	1,270	869,950	Lakehead Bridge
2000	Coho/Late	Fall 2000	432	140	1,683	235,620	Lakehead Bridge

NK = not known

In order to determine brood year contribution to total coho salmon smolt production, the age composition, based on annual sampling, was applied to the coho smolt population estimate for each project year. In both years, age 1.0 smolts made up the majority of the coho salmon out-migration as 85.1% and 77.4% of smolts were age 1.0 for sample years 2001 and 2002, respectively (Table 21). Total smolt production by brood year is presented in Table 22.

Table 21. Estimates of brood year contribution to the total number of coho salmon smolts produced in the upper Capilano River in 2001 and 2002.

Smolt Population Estimate		Brood Year Contribution		
Sample Year	Estimate	Brood Year	Percent	Estimate
2001	54,577	1998	14.9 % (Age 2.0)	8,132
		1999	85.1 % (Age 1.0)	46,445
2002	47,448	1999	22.6 % (Age 2.0)	10,723
		2000	77.4 % (Age 1.0)	36,725

Table 22. Total production estimates, by brood year, of coho salmon smolts from the upper Capilano River for the years 1998 to 2000.

Brood Year	Total Smolt Production Estimates		
	Age 1.0	Age 2.0	Total
1998	Unknown	8,132	Unknown
1999	46,445	10,723	57,168
2000	36,725	Unknown	Unknown

The estimated coho salmon smolt production associated with the release of hatchery fry and adults into the upper Capilano River from the 1999 brood was 57,168 fish (Table 22). Table 23 presents a summary of estimated egg deposition and fry releases for the 1999 brood with incrementally increasing egg to smolt survival rates and the corresponding fry to smolt survivals required to produce the population estimate. Note that the fed fry release value does not include those that were released into the reservoir or reservoir tributaries as it is assumed that these fish would not have migrated upstream to rear in the upper Capilano River upstream of the Lakehead Bridge sampling site (Table 19; Figure 2).

Table 23. Summary of survival rates required to produce the estimated coho salmon smolt population from the release of 1999 brood year coho salmon fry and adults.

Adult Releases			Fry Releases			
Estimated Egg Deposition	Egg to Smolt Survival (%)	Smolts From Egg Deposition	Fed Fry Release	Fry to Smolt Survival (%)	Smolts From Fry Released	Total Smolt Production
806,774	1.0	8,068	112,540	44	49,100	57,168
806,774	1.5	12,102	112,540	40	45,066	57,168
806,774	2.0	16,135	112,540	36	41,033	57,168
806,774	2.5	20,169	112,540	33	36,999	57,168
806,774	3.0	24,203	112,540	29	32,965	57,168
806,774	3.5	28,237	112,540	26	28,931	57,168
806,774	4.0	32,271	112,540	22	24,897	57,168
806,774	4.5	36,305	112,540	19	20,863	57,168
806,774	5.0	40,339	112,540	15	16,829	57,168
806,774	5.5	44,373	112,540	11	12,795	57,168
806,774	6.0	48,406	112,540	8	8,762	57,168

An interpretation of Table 23 requires some understanding of expected egg to smolt and fry to smolt survival rates. Bradford *et al.* (2000) reviewed 14 data sets collected from the literature and unpublished sources that contained annual estimates of female coho salmon spawners and the number of smolts that they produced. All of the data sets were from coastal streams located along the western slope of North America from Oregon to central British

Columbia. They found that the average egg to smolt survival was 3.8% (or 85 smolts produced per female with an average fecundity of 2,250 eggs). A five year study of wild coho salmon from the Salmon River, Langley, British Columbia found that egg to smolt survival ranged from 2.0 to 3.1% and averaged 2.5% based on an estimated average fecundity of 2,500 eggs per female (Joe Tadey, Fisheries and Oceans Canada, Delta, BC, pers. comm.). Reported values of wild coho salmon fry to smolt survival range from 10 to 30% (Bradford *et al.* 2000). In the Quinsam River, British Columbia, fed fry to smolt survivals for hatchery coho salmon released into the river ranged from 14 to 32% and averaged 22% over a 19 year period (Dave Ewart, Fisheries and Oceans Canada, Quinsam River Hatchery, BC, pers. comm.).

In order to achieve the level of smolt production indicated for the 1999 brood year, survivals must have been in the range of values reported for other systems. This result suggests that the upper Capilano River watershed provides good habitat for coho salmon spawning and rearing. Consequently, without hatchery transplants into the upper Capilano River, the rearing capacity lost due to the construction of the Cleveland dam is extensive. It further implies that present stocking levels do not likely exceed carrying capacity. However, since only one complete brood was assessed, it is recommended that stocking practises remain stable until further data is collected. It is also recommended that if there is a continuation of transplanting both the adult and fry life stages to the upper Capilano watershed, all fry releases should be permanently marked (e.g. fin clipped). This will allow future studies to assign the estimated upper Capilano River production to the appropriate life history stage (i.e. survival from adult transplants or survival from fry transplants).

Several recent investigations have explored the relationship between accessible stream length and productive capacity for coho salmon (Marshall and Britton 1990, Holtby *et al.* 1990, Bradford *et al.* 1997, Bradford *et al.* 2000). While this approach was not rigorously pursued in the current study, a very general comparison of predicted smolt production based on this relationship (approximately 25 km of accessible stream length) indicates that the Capilano River upstream of the reservoir is on the upper end of the productivity scale. It would be worthwhile to carry out a more extensive assessment of this relationship to further examine the productive capacity of the upper Capilano River for coho salmon.

While survival rates and accessible stream length can provide insight into the productive capacity of a system, the condition coefficient (K value) of smolts can also serve as an index of productivity (Nikolsky 1963). McHenry (1977) used the K value as an index of carrying capacity after finding that lower stocking densities of hatchery coho salmon juveniles resulted in superior smolts as evidenced by condition factors exceeding 1.0. In a study conducted at the Capilano Salmon Hatchery, an increase in the rearing densities of juvenile coho salmon was associated with a decrease in condition coefficient (Fagerlund *et al.* 1983). The generally high level of smolt health evidenced by the condition coefficients reported here for coho salmon smolts migrating out of the upper Capilano River during 2001 and 2002 suggests that the system can support the current levels of stocking. However, since many factors influence the inter-annual productivity of a watershed and the current data set is limited to two years of sampling, any conclusions reached about the productivity of the system are limited. It is recommended that smolt trapping continue and that extensive biological data be collected from coho salmon smolts

including age, length and weight. The collection of this data will allow a more complete assessment of the condition of smolts produced from the watershed across years and provide additional information on the carrying capacity of the system for coho salmon.

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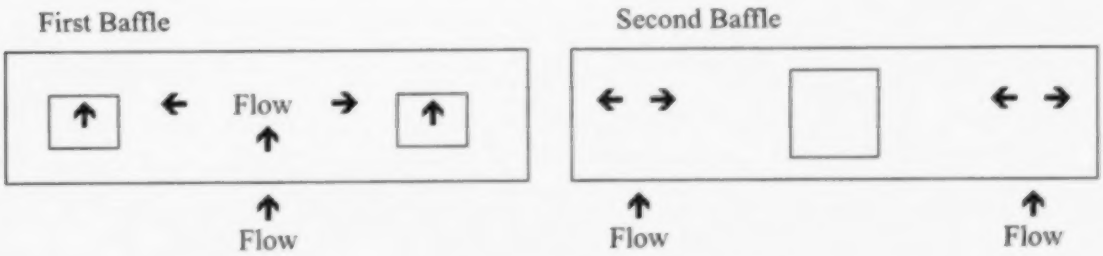
APPENDICES

Appendix 1. Details of the trap box baffling system implemented in 2002.



Two sets of baffles were installed and were made up of 3.1 x 15.2cm untreated wood stacked on top of each other between 3.08cm angle aluminium supports. The baffles had windows cut into them so the fish and some water were forced through into the calmer areas. The dimensions for the wood placement and the aluminium supports are as follows:

- 71.1cm from the front of the trap box to the first baffle.
- 99.0cm from the front of the trap box to the second baffle.
- 45.7cm from bottom of baffle to top for both sets of baffles. The baffles were approximately 12.7cm out of the water, so that water would be forced over the top into the calmer areas.

The first baffle system had two windows to allow the fish to exit into the calmer areas. The windows were:

- 15.2cm from each side of the trap box.
- 6.3cm from the bottom of the trap box.
- Each of the two windows was 12.7cm x 15.2cm

The second baffle system had one window to allow fish into the very back of the trap box.

- 66.0cm to either side of the window from trap box side.
- 6.3cm from the bottom of the trap box.
- The window is the same dimension as the windows for the first baffle 12.7 x 15.2cm.

The angled aluminium was bolted on the inside of the trap box to the sides. Two 45.7cm long pieces of aluminium were used per side to keep the wood baffles in place. The top baffle was bolted into the guides to stop it from coming out.

Aluminium plates 30.5 x 152.4cm were bolted to the sides of the trap box along the bottom. The aluminium plates had small slits for water to enter and exit the trap box. The plates were very close to the height of the water in the trap box, to eliminate water from thrashing around the calm areas created by the baffles. The flow would hit the centre of the first baffle and be directed to either side. The flow would then enter through either of the slots and would hit the second baffle and would be directed to either side. The flow would either escape through the screen on the trap box side or go through the middle slot of the second baffle. With each redirection the energy of the flow would lessen until directly behind the second baffle there was calm water for the fish to relax and maintain its strength in a less stressful environment.

Appendix 2. Daily catch of juvenile coho salmon, by trap position, in the upper Capilano River in 2001.

Date	River Level (m)	Water Temp. (^{0}C)	Lakehead Bridge Trap Position			Reservoir Inlet Trap	Total
			P 1	P 2	P 3		
20-Mar	1.48	3.56	26	0	0	0	26
21-Mar	1.30	3.83	20	0	0	0	20
22-Mar	1.18	4.18	14	0	0	10	24
23-Mar	1.09	4.48	18	0	0	4	22
24-Mar	1.15	4.27	13	0	0	4	17
25-Mar	1.81	4.30	NF	NF	NF	18	18
26-Mar	1.53	4.30	27	0	0	2	29
27-Mar	1.32	4.30	52	0	0	32	84
28-Mar	1.27	3.50	0	10	0	8	18
29-Mar	1.22	2.85	16	0	0	4	20
30-Mar	1.15	4.26	16	0	0	1	17
31-Mar	1.39	3.57	14	0	0	1	15
01-Apr	1.26	4.38	35	0	0	15	50
02-Apr	1.13	4.16	23	0	0	3	26
03-Apr	1.06	4.78	10	0	0	1	11
04-Apr	1.02	5.16	6	0	0	NF	6
05-Apr	1.10	2.39	3	0	0	1	4
06-Apr	1.13	3.16	3	0	0	1	4
07-Apr	1.04	3.84	4	0	0	1	5
08-Apr	1.00	4.85	4	0	0	1	5
09-Apr	0.98	4.17	1	0	0	NF	1
10-Apr	0.97	4.19	6	0	0	NF	6
11-Apr	0.94	5.29	14	0	0	NF	14
12-Apr	0.93	4.07	7	0	0	NF	7
13-Apr	0.91	4.83	NF	NF	NF	NF	NF
14-Apr	0.91	3.85	NF	NF	NF	NF	NF
15-Apr	0.89	6.06	NF	NF	NF	NF	NF
16-Apr	0.88	5.83	NF	NF	NF	NF	NF
17-Apr	0.96	4.19	24	0	0	14	38
18-Apr	1.56	4.63	110	0	0	103	213
19-Apr	1.49	4.89	111	0	0	83	194
20-Apr	1.27	5.61	85	0	0	33	118
21-Apr	1.17	6.44	62	0	0	18	80
22-Apr	1.18	4.86	83	0	0	25	108
23-Apr	1.26	4.35	98	0	0	48	146
24-Apr	1.68	4.43	0	93	0	94	187
25-Apr	1.99	6.15	0	238	0	142	380
26-Apr	1.77	6.01	0	228	0	127	355

Appendix 2. (continued).

Date	River Level (m)	Water Temp. (^{0}C)	Lakehead Bridge Trap Position			Reservoir Inlet Trap	Total
			P 1	P 2	P 3		
27-Apr	1.69	5.10	0	174	0	101	275
28-Apr	1.66	5.49	0	82	0	45	127
29-Apr	1.69	4.21	0	44	0	44	88
30-Apr	1.80	4.67	0	57	0	43	100
01-May	1.49	5.38	69	0	0	35	104
02-May	1.32	6.25	73	0	0	24	97
03-May	1.24	5.41	42	0	0	16	58
04-May	1.49	5.05	21	0	0	9	30
05-May	1.48	NR	144	0	0	101	245
06-May	1.29	6.41	108	0	0	33	141
07-May	1.23	6.15	44	0	0	12	56
08-May	1.27	7.17	70	0	0	12	82
09-May	1.26	6.91	112	0	0	32	144
10-May	1.22	7.46	128	0	0	27	155
11-May	1.25	7.78	65	0	0	20	85
12-May	1.44	NR	206	0	0	67	273
13-May	1.43	6.77	278	0	0	126	404
14-May	2.30	5.01	187	0	0	31	218
15-May	1.64	5.59	NF	NF	NF	NF	NF
16-May	1.68	5.77	NF	NF	NF	63	63
17-May[1]	1.41	5.49	NF	NF	NF	41	41
18-May	1.28	5.83	NF	NF	NF	16	16
19-May	1.27	NR	NF	NF	NF	9	9
20-May	1.25	7.61	60	0	0	9	69
21-May	1.31	8.65	35	0	0	2	37
22-May	1.64	8.83	116	0	0	29	145
23-May	1.81	8.56	213	0	0	53	266
24-May	1.67	8.42	122	0	0	35	157
25-May	1.59	8.64	87	0	0	29	116
26-May	1.56	9.00	47	0	0	13	60
27-May	1.45	7.83	37	0	0	6	43
28-May	NR	6.40	26	0	0	3	29
29-May	1.30	6.85	36	0	0	6	42
30-May	1.18	6.65	47	0	0	NF	47
31-May[2]	1.26	9.24	31	0	0	NF	31
01-Jun	1.71	7.03	24	20	0	NF	44
02-Jun	1.41	6.92	28	20	0	NF	48
03-Jun	1.25	7.54	15	8	0	NF	23
04-Jun	1.18	7.29	14	24	0	NF	38

Appendix 2. (continued).

Date	River Level (m)	Water Temp. (^{0}C)	Lakehead Bridge Trap Position			Reservoir Inlet Trap	Total
			P 1	P 2	P 3		
05-Jun	1.15	7.23	8	4	0	NF	12
06-Jun	1.24	7.85	7	6	0	NF	13
07-Jun	1.22	8.48	21	9	0	NF	30
08-Jun	1.24	8.32	22	15	0	NF	37
09-Jun	1.50	8.10	32	43	0	NF	75
10-Jun	1.46	6.78	17	25	0	NF	42
11-Jun	1.34	NR	0	8	3	NF	11
12-Jun	1.33	8.55	11	23	0	NF	34
13-Jun	1.23	8.76	4	7	0	NF	11
Total			3,512	1,138	3	1,886	6,539

[1] Inlet trap moved slightly upstream due to rising reservoir levels.

[2] Inlet trap moved to Lakehead Bridge site for duration of the project.

NF = Not Fishing.

NR = Not Recorded.

Appendix 3. Daily catch of juvenile steelhead salmon, by trap position, in the upper Capilano River in 2001.

Date	River Level (m)	Water Temp. (^{0}C)	Lakehead Bridge Trap Position			Reservoir Inlet Trap	Total
			P 1	P 2	P 3		
20-Mar	1.48	3.56	4	0	0	0	4
21-Mar	1.30	3.83	1	0	0	0	1
22-Mar	1.18	4.18	0	0	0	0	0
23-Mar	1.09	4.48	0	0	0	0	0
24-Mar	1.15	4.27	1	0	0	0	1
25-Mar	1.81	4.30	NF	NF	NF	6	6
26-Mar	1.53	4.30	3	0	0	0	3
27-Mar	1.32	4.30	0	0	0	0	0
28-Mar	1.27	3.50	0	0	0	0	0
29-Mar	1.22	2.85	0	0	0	0	0
30-Mar	1.15	4.26	1	0	0	0	1
31-Mar	1.39	3.57	0	0	0	0	0
01-Apr	1.26	4.38	2	0	0	1	3
02-Apr	1.13	4.16	0	0	0	0	0
03-Apr	1.06	4.78	0	0	0	0	0
04-Apr	1.02	5.16	0	0	0	NF	0
05-Apr	1.10	2.39	0	0	0	0	0
06-Apr	1.13	3.16	0	0	0	0	0
07-Apr	1.04	3.84	0	0	0	0	0
08-Apr	1.00	4.85	0	0	0	0	0
09-Apr	0.98	4.17	0	0	0	NF	0
10-Apr	0.97	4.19	0	0	0	NF	0
11-Apr	0.94	5.29	0	0	0	NF	0
12-Apr	0.93	4.07	0	0	0	NF	0
13-Apr	0.91	4.83	NF	NF	NF	NF	NF
14-Apr	0.91	3.85	NF	NF	NF	NF	NF
15-Apr	0.89	6.06	NF	NF	NF	NF	NF
16-Apr	0.88	5.83	NF	NF	NF	NF	NF
17-Apr	0.96	4.19	4	0	0	0	4
18-Apr	1.56	4.63	5	0	0	2	7
19-Apr	1.49	4.89	3	0	0	1	4
20-Apr	1.27	5.61	0	0	0	0	0
21-Apr	1.17	6.44	0	0	0	0	0
22-Apr	1.18	4.86	3	0	0	0	3
23-Apr	1.26	4.35	4	0	0	1	5
24-Apr	1.68	4.43	0	6	0	5	11
25-Apr	1.99	6.15	0	14	0	5	19
26-Apr	1.77	6.01	0	11	0	5	16

Appendix 3. (continued).

Date	River Level (m)	Water Temp. (^{0}C)	Lakehead Bridge Trap Position			Reservoir Inlet Trap	Total
			P 1	P 2	P 3		
27-Apr	1.69	5.10	0	11	0	1	12
28-Apr	1.66	5.49	0	13	0	2	15
29-Apr	1.69	4.21	0	2	0	1	3
30-Apr	1.80	4.67	0	3	0	1	4
01-May	1.49	5.38	3	0	0	3	6
02-May	1.32	6.25	0	0	0	0	0
03-May	1.24	5.41	2	0	0	0	2
04-May	1.49	5.05	0	0	0	0	0
05-May	1.48	NR	13	0	0	2	15
06-May	1.29	6.41	1	0	0	0	1
07-May	1.23	6.15	1	0	0	0	1
08-May	1.27	7.17	2	0	0	0	2
09-May	1.26	6.91	3	0	0	0	3
10-May	1.22	7.46	2	0	0	0	2
11-May	1.25	7.78	2	0	0	0	2
12-May	1.44	NR	7	0	0	3	10
13-May	1.43	6.77	16	0	0	6	22
14-May	2.30	5.01	3	0	0	1	4
15-May	1.64	5.59	NF	NF	NF	NF	NF
16-May	1.68	5.77	NF	NF	NF	0	0
17-May[1]	1.41	5.49	NF	NF	NF	0	0
18-May	1.28	5.83	NF	NF	NF	0	0
19-May	1.27	NR	NF	NF	NF	0	0
20-May	1.25	7.61	0	0	0	0	0
21-May	1.31	8.65	3	0	0	0	3
22-May	1.64	8.83	6	0	0	0	6
23-May	1.81	8.56	6	0	0	0	6
24-May	1.67	8.42	8	0	0	2	10
25-May	1.59	8.64	2	0	0	0	2
26-May	1.56	9.00	3	0	0	0	3
27-May	1.45	7.83	2	0	0	0	2
28-May	NR	6.40	1	0	0	0	1
29-May	1.30	6.85	0	0	0	0	0
30-May	1.18	6.65	1	0	0	NF	1
31-May[2]	1.26	9.24	0	0	0	NF	0
01-Jun	1.71	7.03	2	0	0	NF	2
02-Jun	1.41	6.92	2	1	0	NF	3
03-Jun	1.25	7.54	2	1	0	NF	3
04-Jun	1.18	7.29	0	0	0	NF	0

Appendix 3. (continued).

Date	River Level (m)	Water Temp. (^{0}C)	Lakehead Bridge Trap Position			Reservoir Inlet Trap	Total
			P 1	P 2	P 3		
05-Jun	1.15	7.23	0	0	0	NF	0
06-Jun	1.24	7.85	0	0	0	NF	0
07-Jun	1.22	8.48	1	0	0	NF	1
08-Jun	1.24	8.32	1	1	0	NF	2
09-Jun	1.50	8.10	0	0	0	NF	0
10-Jun	1.46	6.78	2	0	0	NF	2
11-Jun	1.34	NR	0	0	1	NF	1
12-Jun	1.33	8.55	0	1	0	NF	1
13-Jun	1.23	8.76	0	0	0	NF	0
Total			128	64	1	48	241

[1] Inlet trap moved slightly upstream due to rising reservoir levels.

[2] Inlet trap moved to Lakehead Bridge site for duration of the project.

NF = Not Fishing.

NR = Not Recorded.

Appendix 4. Daily catch of live and dead coho and steelhead salmon smolts in the RSTs deployed in the upper Capilano River in 2001.

Date	River Level (m)	Coho				Steelhead			
		Live	Dead	Total	% Dead	Live	Dead	Total	% Dead
20-Mar	1.48	12	14	26	53.8%	4	0	4	0.0%
21-Mar	1.30	10	10	20	50.0%	1	0	1	0.0%
22-Mar	1.18	24	0	24	0.0%	0	0	0	
23-Mar	1.09	22	0	22	0.0%	0	0	0	
24-Mar	1.15	17	0	17	0.0%	1	0	1	0.0%
25-Mar	1.81	16	2	18	11.1%	6	0	6	0.0%
26-Mar	1.53	3	26	29	89.7%	1	2	3	66.7%
27-Mar	1.32	80	4	84	4.8%	0	0	0	
28-Mar	1.27	17	1	18	5.6%	0	0	0	
29-Mar	1.22	19	1	20	5.0%	0	0	0	
30-Mar	1.15	14	3	17	17.6%	1	0	1	0.0%
31-Mar	1.39	15	0	15	0.0%	0	0	0	
01-Apr	1.26	41	9	50	18.0%	3	0	3	0.0%
02-Apr	1.13	26	0	26	0.0%	0	0	0	
03-Apr	1.06	11	0	11	0.0%	0	0	0	
04-Apr	1.02	6	0	6	0.0%	0	0	0	
05-Apr	1.10	4	0	4	0.0%	0	0	0	
06-Apr	1.13	4	0	4	0.0%	0	0	0	
07-Apr	1.04	5	0	5	.0%	0	0	0	
08-Apr	1.00	5	0	5	0.0%	0	0	0	
09-Apr	0.98	1	0	1	0.0%	0	0	0	
10-Apr	0.97	6	0	6	0.0%	0	0	0	
11-Apr	0.94	14	0	14	0.0%	0	0	0	
12-Apr	0.93	7	0	7	0.0%	0	0	0	
13-Apr	0.91	NF	NF	NF	NF	NF	NF	NF	NF
14-Apr	0.91	NF	NF	NF	NF	NF	NF	NF	NF
15-Apr	0.89	NF	NF	NF	NF	NF	NF	NF	NF
16-Apr	0.88	NF	NF	NF	NF	NF	NF	NF	NF
17-Apr	0.96	38	0	38	0.0%	4	0	4	0.0%
18-Apr	1.56	180	33	213	15.5%	7	0	7	0.0%
19-Apr	1.49	189	5	194	2.6%	4	0	4	0.0%
20-Apr	1.27	117	1	118	0.8%	0	0	0	
21-Apr	1.17	80	0	80	0.0%	0	0	0	
22-Apr	1.18	107	1	108	0.9%	3	0	3	0.0%
23-Apr	1.26	127	19	146	13.0%	5	0	5	0.0%
24-Apr	1.68	152	35	187	18.7%	11	0	11	0.0%
25-Apr	1.99	153	227	380	59.7%	18	1	19	5.3%
26-Apr	1.77	138	217	355	61.1%	16	0	16	0.0%

Appendix 4. (continued).

Date	River Level (m)	Coho				Steelhead			
		Live	Dead	Total	% Dead	Live	Dead	Total	% Dead
27-Apr	1.69	125	150	275	54.5%	12	0	12	0.0%
28-Apr	1.66	63	64	127	50.4%	15	0	15	0.0%
29-Apr	1.69	87	1	88	1.1%	3	0	3	0.0%
30-Apr	1.80	80	20	100	20.0%	4	0	4	0.0%
01-May	1.49	81	23	104	22.1%	6	0	6	0.0%
02-May	1.32	93	4	97	4.1%	0	0	0	
03-May	1.24	57	1	58	1.7%	2	0	2	0.0%
04-May	1.49	30	0	30	0.0%	0	0	0	
05-May	1.48	202	43	245	17.6%	15	0	15	0.0%
06-May	1.29	136	5	141	3.5%	1	0	1	0.0%
07-May	1.23	56	0	56	0.0%	1	0	1	0.0%
08-May	1.27	82	0	82	0.0%	2	0	2	0.0%
09-May	1.26	143	1	144	0.7%	3	0	3	0.0%
10-May	1.22	153	2	155	1.3%	2	0	2	0.0%
11-May	1.25	85	0	85	0.0%	0	2	2	100.0%
12-May	1.44	271	2	273	0.7%	10	0	10	0.0%
13-May	1.43	347	57	404	14.1%	22	0	22	0.0%
14-May	2.30	202	16	218	7.3%	4	0	4	0.0%
15-May	1.64	NF	NF	NF	NF	NF	NF	NF	NF
16-May	1.68	63	0	63	0.0%	0	0	0	
17-May[1]	1.41	40	1	41	2.4%	0	0	0	
18-May	1.28	16	0	16	0.0%	0	0	0	
19-May	1.27	9	0	9	0.0%	0	0	0	
20-May	1.25	65	4	69	5.8%	0	0	0	
21-May	1.31	37	0	37	0.0%	3	0	3	0.0%
22-May	1.64	141	4	145	2.8%	6	0	6	0.0%
23-May	1.81	228	38	266	14.3%	6	0	6	0.0%
24-May	1.67	134	23	157	14.6%	10	0	10	0.0%
25-May	1.59	69	47	116	40.5%	2	0	2	0.0%
26-May	1.56	54	6	60	10.0%	3	0	3	0.0%
27-May	1.45	40	3	43	7.0%	2	0	2	0.0%
28-May	NR	28	1	29	3.4%	1	0	1	0.0%
29-May	1.30	39	3	42	7.1%	0	0	0	
30-May	1.18	47	0	47	0.0%	1	0	1	0.0%
31-May[2]	1.26	31	0	31	0.0%	0	0	0	
01-Jun	1.71	42	2	44	4.5%	2	0	2	0.0%
02-Jun	1.41	47	1	48	2.1%	3	0	3	0.0%
03-Jun	1.25	23	0	23	0.0%	3	0	3	0.0%
04-Jun	1.18	38	0	38	0.0%	0	0	0	

Appendix 4. (continued).

Date	River Level (m)	Coho				Steelhead			
		Live	Dead	Total	% Dead	Live	Dead	Total	% Dead
05-Jun	1.15	12	0	12	0.0%	0	0	0	
06-Jun	1.24	13	0	13	0.0%	1	0	1	0.0%
07-Jun	1.22	30	0	30	0.0%	2	0	2	0.0%
08-Jun	1.24	37	0	37	0.0%	0	0	0	
09-Jun	1.50	75	0	75	0.0%	2	0	2	0.0%
10-Jun	1.46	42	0	42	0.0%	1	0	1	0.0%
11-Jun	1.34	11	0	11	0.0%	1	0	1	0.0%
12-Jun	1.33	30	4	34	11.8%	0	0	0	
13-Jun	1.23	8	3	11	27.3%	0	0	0	
Total		5,402	1,137	6,539	17.4%	236	5	241	2.1%

[1] Inlet trap moved slightly upstream due to rising reservoir levels.

[2] Inlet trap moved to Lakehead Bridge site for duration of the project.

NF = Not Fishing.

NR = Not Recorded

Appendix 5. Daily catch of coho salmon smolts, by trap position, in the upper Capilano River in 2002.

Date	River Level (m)	Water Temp. (^{0}C)	Lakehead Bridge Trap Location						Total
			P 1	P 2	P 3	P 4	P 5	P 6	
20-Mar	0.90	1.39	NF	NF	0	NF	NF	NF	0
21-Mar	0.88	1.91	NF	NF	0	NF	NF	NF	0
22-Mar	0.90	2.49	NF	NF	0	NF	NF	NF	0
23-Mar	0.95	2.79	4	NF	0	NF	NF	NF	4
24-Mar	1.03	2.77	0	NF	0	NF	NF	NF	0
25-Mar	1.10	2.66	0	NF	0	NF	NF	NF	0
26-Mar	1.16	2.57	0	1	2	0	NF	NF	3
27-Mar	1.17	2.28	5	1	1	1	NF	NF	8
28-Mar	1.11	2.99	23	0	3	1	NF	NF	27
29-Mar	1.09	2.86	10	NF	1	NF	NF	NF	11
30-Mar	1.09	3.08	5	NF	3	NF	NF	NF	8
31-Mar	1.10	3.26	10	NF	4	NF	NF	NF	14
01-Apr	1.20	3.39	17	NF	2	NF	NF	NF	19
02-Apr	1.14	3.15	39	37	14	NF	NF	NF	90
03-Apr	1.09	3.48	32	17	16	NF	NF	NF	65
04-Apr	1.10	3.80	30	NF	11	NF	NF	NF	41
05-Apr	1.27	3.45	38	3	8	NF	NF	NF	49
06-Apr	1.52	3.14	170	100	25	NF	NF	NF	295
07-Apr	1.51	3.40	205	105	25	56	NF	NF	391
08-Apr	1.32	3.54	159	130	25	83	NF	NF	397
09-Apr	1.37	3.41	104	78	20	46	NF	NF	248
10-Apr	1.70	3.32	181	103	27	80	NF	NF	391
11-Apr	1.84	3.28	190	115	35	56	NF	NF	396
12-Apr	2.25	3.11	NF	NF	NF	NF	NF	NF	NF
13-Apr	2.74	2.99	NF	NF	NF	NF	NF	NF	NF
14-Apr	2.46	2.80	NF	NF	NF	NF	NF	NF	NF
15-Apr	1.78	2.94	NF	NF	NF	NF	NF	NF	NF
16-Apr	1.58	2.80	NF	101	8	NF	NF	NF	109
17-Apr	1.45	3.90	137	40	NF	NF	NF	NF	177
18-Apr	1.37	4.09	142	41	NF	NF	NF	NF	183
19-Apr	1.34	4.32	115	118	43	NF	NF	NF	276
20-Apr	1.35	4.58	116	122	42	NF	NF	NF	280
21-Apr	1.35	4.08	101	104	41	NF	NF	NF	246
22-Apr	1.35	4.23	79	80	24	NF	NF	NF	183
23-Apr	1.31	3.80	106	82	15	NF	NF	NF	203
24-Apr	1.23	3.82	58	42	11	NF	NF	NF	111
25-Apr	1.18	4.46	36	24	4	NF	NF	NF	64
26-Apr	1.20	4.33	19	26	14	NF	NF	NF	59

Appendix 5. (continued).

Date	River Level (m)	Water Temp. (°C)	Lakehead Bridge Trap Location						Total
			P 1	P 2	P 3	P 4	P 5	P 6	
27-Apr	1.20	4.93	33	16	10	NF	NF	NF	59
28-Apr	1.23	5.10	58	53	15	NF	NF	NF	126
29-Apr	1.33	5.19	62	54	10	NF	NF	NF	126
30-Apr	1.58	5.06	188	139	22	NF	NF	NF	349
01-May	1.78	4.76	NF	204	181	38	0	NF	423
02-May	1.70	4.22	262	141	26	17	NF	NF	446
03-May	1.51	4.18	99	72	16	38	NF	NF	225
04-May	1.38	4.20	79	50	8	20	NF	NF	157
05-May	1.45	4.17	44	25	5	30	NF	NF	104
06-May	1.31	3.93	110	100	38	54	NF	NF	302
07-May	1.21	4.37	95	88	28	62	NF	NF	273
08-May	1.14	4.85	87	118	46	79	NF	NF	330
09-May	1.10	4.59	72	71	31	NF	NF	NF	174
10-May	1.09	5.49	59	NF	26	NF	NF	NF	85
11-May	1.16	6.03	67	NF	27	NF	NF	NF	94
12-May	1.39	6.05	227	214	63	NF	NF	NF	504
13-May	1.75	4.49	541	368	158	229	NF	NF	1,296
14-May	1.71	4.69	NF	145	111	26	15	NF	297
15-May	1.48	4.88	317	211	45	189	NF	NF	762
16-May	1.38	5.19	164	125	48	118	NF	NF	455
17-May	1.63	5.12	202	135	25	161	NF	NF	523
18-May	1.49	4.96	145	141	32	100	NF	NF	418
19-May	1.46	4.72	141	120	41	98	NF	NF	400
20-May	1.66	4.59	125	118	32	69	NF	NF	344
21-May	1.61	4.72	187	129	NF	NF	NF	NF	316
22-May	1.52	5.00	154	115	16	107	NF	NF	392
23-May	1.51	5.11	129	97	30	NF	NF	167	423
24-May	1.48	5.40	132	97	25	NF	NF	136	390
25-May	1.56	5.27	105	100	20	NF	NF	135	360
26-May	1.59	4.92	152	91	35	NF	NF	180	458
27-May	1.68	5.28	155	101	36	NF	NF	190	482
28-May	2.33	4.76	101	63	21	NF	NF	82	267
29-May	2.35	4.84	NF	NF	NF	NF	7	NF	7
30-May	1.86	5.15	22	151	8	3	NF	NF	184
31-May	1.64	4.87	160	115	70	0	NF	229	574
01-Jun	1.61	6.25	102	77	29	0	NF	98	306
02-Jun	1.69	6.42	71	41	22	0	NF	84	218
03-Jun	1.68	6.12	63	41	17	0	NF	100	221
04-Jun	1.65	5.67	45	34	14	0	NF	78	171

Appendix 5. (continued).

Date	River Level (m)	Water Temp. (°C)	Lakehead Bridge Trap Location						Total
			P 1	P 2	P 3	P 4	P 5	P 6	
05-Jun	1.82	5.62	25	15	11	0	NF	42	93
06-Jun	1.66	5.78	NF	23	11	30	NF	NF	64
07-Jun	1.48	5.61	28	27	13	NF	NF	NF	68
08-Jun	1.36	6.44	13	16	5	NF	NF	NF	34
09-Jun	1.50	7.25	32	33	5	NF	NF	NF	70
10-Jun	1.66	7.04	33	24	8	NF	NF	NF	65
11-Jun	1.68	7.27	19	17	7	NF	NF	NF	43
12-Jun	1.75	7.46	11	9	2	NF	NF	NF	22
13-Jun	1.80	7.56	7	10	NF	NF	NF	NF	17
Total			7,054	5,604	1,873	1,791	22	1,521	17,865

NF = Not Fishing

Appendix 6. Daily catch of steelhead salmon smolts, by trap position, in the upper Capilano River in 2002.

Date	River Level (m)	Water Temp. (°C)	Lakehead Bridge Trap Location						Total
			P 1	P 2	P 3	P 4	P5	P 6	
02-Apr	1.14	3.15	0	1	0	NF	NF	NF	1
03-Apr	1.09	3.48	0	0	0	NF	NF	NF	0
04-Apr	1.10	3.80	0	NF	0	NF	NF	NF	0
05-Apr	1.27	3.45	1	0	0	NF	NF	NF	1
06-Apr	1.52	3.14	1	1	0	NF	NF	NF	2
07-Apr	1.51	3.40	0	1	0	0	NF	NF	1
08-Apr	1.32	3.54	0	0	0	0	NF	NF	0
09-Apr	1.37	3.41	0	1	0	0	NF	NF	1
10-Apr	1.70	3.32	2	0	0	0	NF	NF	2
11-Apr	1.84	3.28	0	0	0	0	NF	NF	0
12-Apr	2.25	3.11	NF	NF	NF	NF	NF	NF	NF
13-Apr	2.74	2.99	NF	NF	NF	NF	NF	NF	NF
14-Apr	2.46	2.80	NF	NF	NF	NF	NF	NF	NF
15-Apr	1.78	2.94	NF	NF	NF	NF	NF	NF	NF
16-Apr	1.58	2.80	NF	0	0	NF	NF	NF	0
17-Apr	1.45	3.90	0	0	NF	NF	NF	NF	0
18-Apr	1.37	4.09	0	0	NF	NF	NF	NF	0
19-Apr	1.34	4.32	0	0	0	NF	NF	NF	0
20-Apr	1.35	4.58	0	1	1	NF	NF	NF	2
21-Apr	1.35	4.08	1	0	0	NF	NF	NF	1
22-Apr	1.35	4.23	1	0	0	NF	NF	NF	1
23-Apr	1.31	3.80	1	0	0	NF	NF	NF	1
24-Apr	1.23	3.82	0	1	0	NF	NF	NF	1
25-Apr	1.18	4.46	1	0	1	NF	NF	NF	2
26-Apr	1.20	4.33	0	0	0	NF	NF	NF	0
27-Apr	1.20	4.93	0	0	0	NF	NF	NF	0
28-Apr	1.23	5.10	0	1	1	NF	NF	NF	2
29-Apr	1.33	5.19	1	0	0	NF	NF	NF	1
30-Apr	1.58	5.06	1	1	0	NF	NF	NF	2
01-May	1.78	4.76	NF	2	5	0	0	NF	7
02-May	1.70	4.22	3	5	0	0	NF	NF	8
03-May	1.51	4.18	5	1	0	0	NF	NF	6
04-May	1.38	4.20	0	0	0	0	NF	NF	0
05-May	1.45	4.17	0	1	0	0	NF	NF	1
06-May	1.31	3.93	0	2	0	0	NF	NF	2
07-May	1.21	4.37	0	2	0	0	NF	NF	2
08-May	1.14	4.85	1	1	0	1	NF	NF	3
09-May	1.10	4.59	0	0	0	NF	NF	NF	0

Appendix 6. (continued)

Date	River Level (m)	Water Temp. (°C)	Lakehead Bridge Trap Location						Total
			P 1	P 2	P 3	P 4	P5	P 6	
10-May	1.09	5.49	0	NF	0	NF	NF	NF	0
11-May	1.16	6.03	0	NF	0	NF	NF	NF	0
12-May	1.39	6.05	1	2	0	NF	NF	NF	3
13-May	1.75	4.49	9	5	2	3	NF	NF	19
14-May	1.71	4.69	NF	5	1	1	0	NF	7
15-May	1.48	4.88	1	1	0	0	NF	NF	2
16-May	1.38	5.19	0	2	0	0	NF	NF	2
17-May	1.63	5.12	1	1	1	7	NF	NF	10
18-May	1.49	4.96	0	3	0	1	NF	NF	4
19-May	1.46	4.72	2	1	0	1	NF	NF	4
20-May	1.66	4.59	3	1	0	1	NF	NF	5
21-May	1.61	4.72	1	3	NF	NF	NF	NF	4
22-May	1.52	5.00	2	6	0	0	NF	NF	8
23-May	1.51	5.11	2	4	0	NF	NF	1	7
24-May	1.48	5.40	2	3	0	NF	NF	2	7
25-May	1.56	5.27	1	2	0	NF	NF	1	4
26-May	1.59	4.92	3	0	0	NF	NF	5	8
27-May	1.68	5.28	1	7	0	NF	NF	3	11
28-May	2.33	4.76	5	2	4	NF	NF	3	14
29-May	2.35	4.84	NF	NF	NF	0	0	NF	0
30-May	1.86	5.15	0	3	0	0	NF	NF	3
31-May	1.64	4.87	1	1	1	0	NF	2	5
01-Jun	1.61	6.25	2	0	0	0	NF	1	3
02-Jun	1.69	6.42	1	1	1	0	NF	2	5
03-Jun	1.68	6.12	3	1	0	0	NF	5	9
04-Jun	1.65	5.67	4	3	0	0	NF	2	9
05-Jun	1.82	5.62	1	0	0	0	NF	2	3
06-Jun	1.66	5.78	NF	0	0	1	NF	NF	1
07-Jun	1.48	5.61	0	1	0	NF	NF	NF	1
08-Jun	1.36	6.44	1	0	0	NF	NF	NF	1
09-Jun	1.50	7.25	0	0	0	NF	NF	NF	0
10-Jun	1.66	7.04	1	0	0	NF	NF	NF	1
11-Jun	1.68	7.27	1	2	0	NF	NF	NF	3
12-Jun	1.75	7.46	1	3	0	NF	NF	NF	4
13-Jun	1.80	7.56	1	0	NF	NF	NF	NF	1
Total			70	85	18	16	0	29	218

NF = Not Fishing

Appendix 7. Daily catch of live and dead coho and steelhead salmon smolts in the RSTs deployed in the upper Capilano River in 2002.

Date	River Level (m)	Coho				Steelhead			
		Live	Dead	Total	% Dead	Live	Dead	Total	% Dead
20-Mar	0.89	0	0	0	0.0%	0	0	0	0.0%
21-Mar	0.88	0	0	0	0.0%	0	0	0	0.0%
22-Mar	0.93	0	0	0	0.0%	0	0	0	0.0%
23-Mar	0.99	4	0	4	0.0%	0	0	0	0.0%
24-Mar	1.08	0	0	0	0.0%	0	0	0	0.0%
25-Mar	1.13	0	0	0	0.0%	0	0	0	0.0%
26-Mar	1.22	3	0	3	0.0%	0	0	0	0.0%
27-Mar	1.14	8	0	8	0.0%	0	0	0	0.0%
28-Mar	1.11	27	0	27	0.0%	0	0	0	0.0%
29-Mar	1.10	11	0	11	0.0%	0	0	0	0.0%
30-Mar	1.09	8	0	8	0.0%	0	0	0	0.0%
31-Mar	1.16	14	0	14	0.0%	0	0	0	0.0%
01-Apr	1.18	19	0	19	0.0%	0	0	0	0.0%
02-Apr	1.11	90	0	90	0.0%	1	0	1	0.0%
03-Apr	1.10	65	0	65	0.0%	0	0	0	0.0%
04-Apr	1.18	41	0	41	0.0%	0	0	0	0.0%
05-Apr	1.41	49	0	49	0.0%	1	0	1	0.0%
06-Apr	1.60	294	1	295	0.3%	2	0	2	0.0%
07-Apr	1.39	391	0	391	0.0%	1	0	1	0.0%
08-Apr	1.27	396	1	397	0.3%	0	0	0	0.0%
09-Apr	1.67	248	0	248	0.0%	1	0	1	0.0%
10-Apr	1.73	389	2	391	0.5%	2	0	2	0.0%
11-Apr	2.28	395	1	396	0.3%	0	0	0	0.0%
12-Apr	2.67	NF	NF	NF	NF	NF	NF	NF	NF
13-Apr	2.92	NF	NF	NF	NF	NF	NF	NF	NF
14-Apr	1.97	NF	NF	NF	NF	NF	NF	NF	NF
15-Apr	1.67	NF	NF	NF	NF	NF	NF	NF	NF
16-Apr	1.52	109	0	109	0.0%	0	0	0	0.0%
17-Apr	1.41	177	0	177	0.0%	0	0	0	0.0%
18-Apr	1.37	183	0	183	0.0%	0	0	0	0.0%
19-Apr	1.36	276	0	276	0.0%	0	0	0	0.0%
20-Apr	1.36	280	0	280	0.0%	2	0	2	0.0%
21-Apr	1.33	246	0	246	0.0%	1	0	1	0.0%
22-Apr	1.37	178	5	183	2.7%	1	0	1	0.0%
23-Apr	1.27	203	0	203	0.0%	1	0	1	0.0%
24-Apr	1.20	110	1	111	0.9%	1	0	1	0.0%
25-Apr	1.18	64	0	64	0.0%	2	0	2	0.0%
26-Apr	1.22	58	1	59	1.7%	0	0	0	0.0%

Appendix 7. (continued)

Date	River Level (m)	Coho				Steelhead			
		Live	Dead	Total	% Dead	Live	Dead	Total	% Dead
27-Apr	1.23	59	0	59	0.0%	0	0	0	0.0%
28-Apr	1.29	126	0	126	0.0%	2	0	2	0.0%
29-Apr	1.47	126	0	126	0.0%	1	0	1	0.0%
30-Apr	1.82	347	2	349	0.6%	2	0	2	0.0%
01-May	1.83	422	1	423	0.2%	7	0	7	0.0%
02-May	1.61	444	2	446	0.4%	8	0	8	0.0%
03-May	1.43	223	2	225	0.9%	6	0	6	0.0%
04-May	1.43	157	0	157	0.0%	0	0	0	0.0%
05-May	1.37	104	0	104	0.0%	1	0	1	0.0%
06-May	1.26	298	4	302	1.3%	2	0	2	0.0%
07-May	1.18	270	3	273	1.1%	2	0	2	0.0%
08-May	1.12	330	0	330	0.0%	3	0	3	0.0%
09-May	1.09	174	0	174	0.0%	0	0	0	0.0%
10-May	1.14	85	0	85	0.0%	0	0	0	0.0%
11-May	1.28	94	0	94	0.0%	0	0	0	0.0%
12-May	1.67	504	0	504	0.0%	3	0	3	0.0%
13-May	1.89	1,291	5	1,296	0.4%	18	1	19	5.3%
14-May	1.73	297	0	297	0.0%	7	0	7	0.0%
15-May	1.96	762	0	762	0.0%	2	0	2	0.0%
16-May	1.43	455	0	455	0.0%	2	0	2	0.0%
17-May	1.73	520	3	523	0.6%	10	0	10	0.0%
18-May	1.52	418	0	418	0.0%	4	0	4	0.0%
19-May	1.48	400	0	400	0.0%	4	0	4	0.0%
20-May	1.58	344	0	344	0.0%	5	0	5	0.0%
21-May	1.68	314	2	316	0.6%	4	0	4	0.0%
22-May	1.53	392	0	392	0.0%	8	0	8	0.0%
23-May	1.50	422	1	423	0.2%	7	0	7	0.0%
24-May	1.49	390	0	390	0.0%	7	0	7	0.0%
25-May	1.52	360	0	360	0.0%	4	0	4	0.0%
26-May	1.60	457	1	458	0.2%	8	0	8	0.0%
27-May	1.64	478	4	482	0.8%	11	0	11	0.0%
28-May	2.35	151	116	267	43.4%	11	2	13	15.4%
29-May	2.55	7	0	7	0.0%	1	0	1	0.0%
30-May	2.00	162	22	184	12.0%	3	0	3	0.0%
31-May	1.80	550	24	574	4.2%	5	0	5	0.0%
01-Jun	1.60	306	0	306	0.0%	3	0	3	0.0%
02-Jun	1.68	214	4	218	1.8%	5	0	5	0.0%
03-Jun	1.74	219	2	221	0.9%	9	0	9	0.0%
04-Jun	1.68	171	0	171	0.0%	9	0	9	0.0%

Appendix 7. (continued)

Date	River Level (m)	Coho				Steelhead			
		Live	Dead	Total	% Dead	Live	Dead	Total	% Dead
05-Jun	1.92	93	0	93	0.0%	3	0	3	0.0%
06-Jun	1.72	64	0	64	0.0%	1	0	1	0.0%
07-Jun	1.50	68	0	68	0.0%	1	0	1	0.0%
08-Jun	1.37	34	0	34	0.0%	1	0	1	0.0%
09-Jun	1.45	70	0	70	0.0%	0	0	0	0.0%
10-Jun	1.70	62	3	65	4.6%	1	0	1	0.0%
11-Jun	1.67	43	0	43	0.0%	3	0	3	0.0%
12-Jun	1.70	22	0	22	0.0%	4	0	4	0.0%
13-Jun	1.81	17	0	17	0.0%	1	0	1	0.0%
Total		17,652	213	17,865	1.2%	215	3	218	1.4%

NF = Not Fishing

Appendix 8. Environmental data collected at the Lakehead Bridge site, upper Capilano River in 2001 and 2002.

	2001			2002				
	Water Temp.	River Level	Discharge Volume	Water Temp.	River Level (m)			Discharge Volume
Date	(°C)	(m)	($m^3 \cdot s^{-1}$)	(°C)	Min.	Max.	Mean	($m^3 \cdot s^{-1}$)
20-Mar	3.56	1.48	46.47	1.39	0.89	0.91	0.90	4.49
21-Mar	3.83	1.30	46.10	1.91	0.88	0.89	0.88	4.24
22-Mar	4.18	1.18	46.10	2.49	0.88	0.93	0.90	4.50
23-Mar	4.48	1.09	46.10	2.79	0.93	0.99	0.95	5.67
24-Mar	4.27	1.15	46.10	2.77	0.99	1.08	1.03	7.58
25-Mar	4.30	1.81	46.10	2.66	1.08	1.13	1.10	9.65
26-Mar	4.30	1.53	37.86	2.57	1.13	1.23	1.16	11.90
27-Mar	4.30	1.32	19.29	2.28	1.14	1.22	1.17	12.03
28-Mar	3.50	1.27	17.03	2.99	1.11	1.14	1.11	10.09
29-Mar	2.85	1.22	14.05	2.86	1.09	1.11	1.09	9.51
30-Mar	4.26	1.15	11.77	3.08	1.08	1.11	1.09	9.31
31-Mar	3.57	1.39	17.48	3.26	1.08	1.16	1.10	9.65
01-Apr	4.38	1.26	18.13	3.39	1.16	1.22	1.20	13.10
02-Apr	4.16	1.13	11.77	3.15	1.11	1.18	1.14	11.04
03-Apr	4.78	1.06	8.88	3.48	1.07	1.11	1.09	9.39
04-Apr	5.16	1.02	7.56	3.80	1.09	1.18	1.10	9.95
05-Apr	2.39	1.10	8.80	3.45	1.18	1.42	1.27	16.17
06-Apr	3.16	1.13	10.59	3.14	1.42	1.60	1.52 R	28.17
07-Apr	3.84	1.04	8.51	3.40	1.39	1.61	1.51	27.30
08-Apr	4.85	1.00	6.96	3.54	1.27	1.39	1.32	.17.94
09-Apr	4.17	0.98 R	6.63	3.41	1.24	1.67	1.37	21.25
10-Apr	4.19	0.97	6.14	3.32	1.66	1.73	1.70	38.52
11-Apr	5.29	0.94	5.50	3.28	1.71	2.29	1.84	48.68
12-Apr	4.07	0.93	5.19	3.11	2.10	2.67	2.25	83.23
13-Apr	4.83	0.91	4.97	2.99	2.41	3.00	2.74	168.29
14-Apr	3.85	0.91	4.50	2.80	1.97	3.04	2.46	124.61
15-Apr	6.06	0.89	4.22	2.94	1.67	1.97	1.78	44.45
16-Apr	5.83	0.88	5.45	2.80	1.52	1.67	1.58	31.71
17-Apr	4.19	0.96	26.32	3.90	1.41	1.52	1.45	24.23
18-Apr	4.63	1.56	27.99	4.09	1.34	1.41	1.37	20.34
19-Apr	4.89	1.49 R	18.02	4.32	1.32	1.37	1.34 R	19.09
20-Apr	5.61	1.27	12.93	4.58	1.34	1.36	1.35	19.37
21-Apr	6.44	1.17	12.44	4.08	1.33	1.36	1.35	19.31
22-Apr	4.86	1.18	14.96	4.23	1.33	1.38	1.35	19.56
23-Apr	4.35	1.26	33.86	3.80	1.27	1.37	1.31	17.61
24-Apr	4.43	1.68	46.55	3.82	1.21	1.27	1.23	14.39

Appendix 8. (continued)

Date	2001 Water Temp. (°C)	2001 River Level (m)		2001 Discharge Volume ($m^3 \cdot s^{-1}$)	2002 Water Temp. (°C)	2002 River Level (m) Min.	Max.	Mean		2002 Discharge Volume ($m^3 \cdot s^{-1}$)
25-Apr	6.15	1.99		51.85	4.46	1.17	1.21	1.18		12.62
26-Apr	6.01	1.77	R	40.00	4.33	1.18	1.22	1.20		13.12
27-Apr	5.10	1.69		37.12	4.93	1.18	1.23	1.20		13.21
28-Apr	5.49	1.66		43.16	5.10	1.20	1.29	1.23	R	14.27
29-Apr	4.21	1.69		38.92	5.19	1.28	1.47	1.33		18.48
30-Apr	4.67	1.80		43.77	5.06	1.48	1.82	1.58		31.41
01-May	5.38	1.49		29.97	4.76	1.72	1.83	1.78		44.26
02-May	6.25	1.32	R	19.83	4.22	1.59	1.83	1.70		38.64
03-May	5.41	1.24		15.63	4.18	1.43	1.61	1.51		27.73
04-May	5.05	1.49		22.25	4.20	1.35	1.43	1.38	R	20.93
05-May	NR	1.48		33.09	4.17	1.37	1.52	1.45		24.09
06-May	6.41	1.29		18.26	3.93	1.26	1.37	1.31		17.54
07-May	6.15	1.23		14.64	4.37	1.18	1.26	1.21		13.55
08-May	7.17	1.27		15.73	4.85	1.12	1.18	1.14		11.10
09-May	6.91	1.26	R	16.36	4.59	1.09	1.12	1.10		9.79
10-May	7.46	1.22		14.37	5.49	1.08	1.14	1.09		9.52
11-May	7.78	1.25		14.94	6.03	1.13	1.28	1.16	R	11.88
12-May	NR	1.44		22.27	6.05	1.28	1.67	1.39		21.90
13-May	6.77	1.43		25.00	4.49	1.66	1.90	1.75		41.97
14-May	5.01	2.30		66.29	4.69	1.59	1.89	1.71	R	39.41
15-May	5.59	1.64		43.87	4.88	1.42	1.59	1.48		26.16
16-May	5.77	1.68		45.56	5.19	1.34	1.50	1.38		20.98
17-May	5.49	1.41		24.82	5.12	1.50	1.73	1.63		34.48
18-May	5.83	1.28		21.23	4.96	1.45	1.57	1.49	R	26.56
19-May	NR	1.27		15.93	4.72	1.44	1.49	1.46		24.67
20-May	7.61	1.25		15.93	4.59	1.49	1.77	1.66		36.53
21-May	8.65	1.31		16.77	4.72	1.55	1.71	1.61		33.00
22-May	8.83	1.64	R	30.71	5.00	1.48	1.55	1.52		28.13
23-May	8.56	1.81		43.91	5.11	1.50	1.52	1.51	R	27.29
24-May	8.42	1.67		39.14	5.40	1.46	1.51	1.48		26.08
25-May	8.64	1.59		33.54	5.27	1.50	1.61	1.56		30.00
26-May	9.00	1.56		30.89	4.92	1.57	1.63	1.59		32.21
27-May	7.83	1.45		26.43	5.28	1.63	2.03	1.68		37.56
28-May	6.40	NR		27.97	4.76	2.03	2.76	2.33		94.61
29-May	6.85	1.30		19.66	4.84	2.12	2.76	2.35		95.95
30-May	6.65	1.18		13.28	5.15	1.70	2.12	1.86	R	49.75
31-May	9.24	1.26		13.69	4.87	1.59	1.74	1.64		35.09
01-Jun	7.03	1.71		31.57	6.25	1.57	1.72	1.61		33.46

Appendix 8. (continued)

Date	2001 Water Temp. (°C)	2001 River Level (m)		2001 Discharge Volume ($m^3 \cdot s^{-1}$)	2002 Water Temp. (°C)	2002 River Level (m) Min.	Max.	Mean		2002 Discharge Volume ($m^3 \cdot s^{-1}$)
02-Jun	6.92	1.41		25.77	6.42	1.61	1.78	1.69		38.02
03-Jun	7.54	1.25		16.37	6.12	1.62	1.78	1.68	R	37.57
04-Jun	7.29	1.18		13.22	5.67	1.61	1.69	1.65		35.29
05-Jun	7.23	1.15		11.72	5.62	1.68	1.94	1.82		46.94
06-Jun	7.85	1.24		13.63	5.78	1.56	1.79	1.66	R	36.04
07-Jun	8.48	1.22		14.96	5.61	1.41	1.57	1.48		26.08
08-Jun	8.32	1.24		14.86	6.44	1.33	1.41	1.36		20.08
09-Jun	8.10	1.50	R	27.45	7.25	1.41	1.74	1.50		27.22
10-Jun	6.78	1.46		24.56	7.04	1.58	1.74	1.66		36.43
11-Jun	NR	1.34		19.38	7.27	1.59	1.82	1.68		37.43
12-Jun	8.55	1.33		19.84	7.46	1.63	1.90	1.75		42.04
13-Jun	8.76	1.23		16.18	7.56	1.69	1.92	1.80		45.72
Minimum	2.39	0.88		4.22	1.39	0.88	0.89	0.88		4.24
Maximum	9.24	2.30		66.29	7.56	2.41	3.04	2.74		168.29
Mean	5.82	1.34		23.34	4.42	1.40	1.57	1.47		29.11

R = Release Group of Marked Coho

NR = Not Recorded

Appendix 9. Nose-fork length, weight and condition coefficient (K value), by sample date, for coho and steelhead salmon smolts captured in the upper Capilano River in 2001.

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
17-Apr	75	4.39	1.041	155	35.02	0.940
17-Apr	75	4.3	1.019	152	30.29	0.863
17-Apr	74	4.59	1.133	177	44.4	0.801
17-Apr	98	10.32	1.096			
17-Apr	87	6.43	0.976			
17-Apr	82	5.51	0.999			
17-Apr	80	4.76	0.930			
17-Apr	84	5.94	1.002			
17-Apr	67	3.2	1.064			
17-Apr	72	3.74	1.002			
17-Apr	70	3.67	1.070			
17-Apr	79	5.03	1.020			
17-Apr	69	3.97	1.208			
17-Apr	71	3.42	0.956			
17-Apr	70	3.96	1.155			
17-Apr	88	7.19	1.055			
17-Apr	73	4.39	1.128			
17-Apr	68	3.18	1.011			
17-Apr	75	4.17	0.988			
17-Apr	82	5.03	0.912			
17-Apr	75	4.02	0.953			
17-Apr	110	12.24	0.920			
17-Apr	80	5.09	0.994			
17-Apr	83	6.36	1.112			
17-Apr	70	3.53	1.029			
17-Apr	70	3.59	1.047			
17-Apr	75	4.37	1.036			
17-Apr	76	4.65	1.059			
17-Apr	80	4.83	0.943			
Sample Size	29			3		
Average	78	5.03	1.030	161	36.57	0.868
SD	9.3	2.01	0.073	13.7	7.18	0.070
20-Apr	68	2.95	0.938			
20-Apr	69	3	0.913			

Appendix 9. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
20-Apr	78	4.38	0.923			
20-Apr	73	3.5	0.900			
20-Apr	73	3.45	0.887			
20-Apr	66	2.97	1.033			
20-Apr	73	3.71	0.954			
20-Apr	72	3.52	0.943			
20-Apr	64	2.33	0.889			
20-Apr	67	2.76	0.918			
20-Apr	75	3.69	0.875			
20-Apr	78	3.89	0.820			
20-Apr	70	2.86	0.834			
20-Apr	81	5.01	0.943			
20-Apr	68	2.94	0.935			
20-Apr	80	4.67	0.912			
20-Apr	84	5.49	0.926			
20-Apr	78	4.44	0.936			
20-Apr	74	3.51	0.866			
20-Apr	69	2.88	0.877			
20-Apr	76	4.36	0.993			
20-Apr	79	4.89	0.992			
Sample Size	22					
Average	73	3.69	0.918			
SD	5.4	0.85	0.050			
28-Apr	76	5.01	1.141	170	43.8	0.892
28-Apr	71	3.69	1.031	149	29.59	0.895
28-Apr	75	4.22	1.000	189	53.84	0.797
28-Apr	69	2.77	0.843	146	27.67	0.889
28-Apr	74	4.02	0.992	177	45.05	0.812
28-Apr	86	6.78	1.066	148	28.03	0.865
28-Apr	86	6.01	0.945	164	33.04	0.749
28-Apr	89	7.14	1.013	164	40.66	0.922
28-Apr	83	6.13	1.072	189	55.21	0.818
28-Apr	89	6.83	0.969	185	62.72	0.991
28-Apr	78	4.38	0.923	151	32.59	0.947
28-Apr	73	4.22	1.085	133	19.03	0.809
28-Apr	83	6.15	1.076	172	44	0.865

Appendix 9. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
28-Apr	73	3.84	0.987	204	69.85	0.823
28-Apr	75	4.58	1.086			
28-Apr	81	5.13	0.965			
28-Apr	65	3.02	1.100			
28-Apr	81	4.88	0.918			
28-Apr	81	5.3	0.997			
28-Apr	80	5.01	0.979			
28-Apr	60	2.29	1.060			
28-Apr	82	5.69	1.032			
28-Apr	66	2.7	0.939			
28-Apr	77	4.62	1.012			
28-Apr	107	11.93	0.974			
28-Apr	80	5.46	1.066			
28-Apr	66	2.83	0.984			
28-Apr	76	4.18	0.952			
28-Apr	100	9.54	0.954			
Sample Size	29			14		
Average	79	5.12	1.006	167	41.79	0.862
SD	10.0	2.04	0.066	20.3	14.65	0.066
05-May	82	5.73	1.039	166	41.52	0.908
05-May	84	5.9	0.995	150	31.71	0.940
05-May	70	3.61	1.052	167	39.43	0.847
05-May	92	8.78	1.128	165	36.2	0.806
05-May	104	11.98	1.065	152	29.76	0.847
05-May	99	9.73	1.003	145	26.79	0.879
05-May	74	4.42	1.091	145	27.33	0.896
05-May	76	4.64	1.057	155	33.2	0.892
05-May	73	4.19	1.077	173	49.59	0.958
05-May	69	3.62	1.102	166	44.57	0.974
05-May	88	7.53	1.105	178	49.15	0.871
05-May	76	4.69	1.068	169	41.2	0.854
05-May	93	8.98	1.116	146	30.49	0.980
05-May	93	8.82	1.097	156	31.88	0.840
05-May	96	9.21	1.041			
05-May	73	4.12	1.059			
05-May	76	4.75	1.082			

Appendix 9. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
05-May	72	3.78	1.013			
05-May	80	5.45	1.064			
05-May	77	5.23	1.146			
05-May	70	3.68	1.073			
05-May	81	6.24	1.174			
05-May	79	4.93	1.000			
05-May	88	7.08	1.039			
05-May	76	4.81	1.096			
Sample Size	25			14		
Average	82	6.08	1.071	160	36.63	0.892
SD	9.9	2.31	0.045	11.0	7.68	0.054
12-May	79	4.93	1.000	177	48.54	0.875
12-May	84	5.92	0.999	184	48.97	0.786
12-May	70	4.26	1.242	158	30.49	0.773
12-May	80	5	0.977	149	47.90	1.448
12-May	88	6.99	1.026	180	48.73	0.836
12-May	95	9.69	1.130	144	25.01	0.838
12-May	81	5.04	0.948	144	24.50	0.821
12-May	115	13.24	0.871	157	31.44	0.812
12-May	93	7.92	0.985	150	30.12	0.892
12-May	67	3.09	1.027	156	34.92	0.920
12-May	91	7.03	0.933			
12-May	84	5.3	0.894			
12-May	82	5.4	0.979			
12-May	88	6.62	0.971			
12-May	73	3.78	0.972			
12-May	79	4.86	0.986			
12-May	92	7.71	0.990			
12-May	83	5.46	0.955			
12-May	81	5.6	1.054			
12-May	83	7.84	1.371			
12-May	81	4.96	0.933			
12-May	94	7.7	0.927			
12-May	74	4.22	1.041			
12-May	80	4.99	0.975			
12-May	78	4.46	0.940			

Appendix 9. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
12-May	75	3.86	0.915			
12-May	82	5.48	0.994			
12-May	71	3.89	1.087			
Sample Size	28			10		
Average	83	5.90	1.004	160	37.06	0.900
SD	9.6	2.11	0.103	15.0	10.32	0.198
20-May	80	4.98	0.973	160	33.10	0.808
20-May	79	5.02	1.018	159	36.69	0.913
20-May	76	4.36	0.993	163	38.05	0.879
20-May	107	13.28	1.084	163	38.40	0.887
20-May	83	5.96	1.042			
20-May	101	10.67	1.036			
20-May	80	5.15	1.006			
20-May	99	9.2	0.948			
20-May	119	16.97	1.007			
20-May	85	6.28	1.023			
20-May	85	6.82	1.111			
20-May	84	5.77	0.974			
20-May	95	9	1.050			
20-May	105	12.39	1.070			
20-May	70	3.62	1.055			
20-May	92	8.94	1.148			
20-May	92	7.37	0.946			
20-May	71	3.6	1.006			
20-May	98	9.22	0.980			
20-May	83	5.85	1.023			
20-May	103	10.18	0.932			
20-May	96	9.13	1.032			
20-May	87	6.4	0.972			
20-May	95	8.56	0.998			
20-May	90	7.76	1.064			
20-May	107	11.36	0.927			
20-May	115	15.38	1.011			
20-May	101	11.08	1.075			
20-May	90	6.89	0.945			
20-May	85	6.43	1.047			

Appendix 9. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
20-May	95	8.4	0.980			
20-May	83	5.73	1.002			
20-May	107	11.72	0.957			
20-May	110	13.49	1.014			
20-May	74	4.15	1.024			
20-May	84	6.88	1.161			
20-May	75	4.5	1.067			
20-May	102	9.98	0.940			
20-May	93	7.83	0.973			
20-May	75	4.73	1.121			
20-May	77	4.58	1.003			
20-May	82	5.8	1.052			
20-May	97	9.24	1.012			
20-May	105	11.48	0.992			
20-May	89	7.36	1.044			
20-May	105	11.97	1.034			
20-May	113	12.85	0.891			
20-May	110	12.63	0.949			
20-May	96	8.5	0.961			
20-May	95	8.92	1.040			
20-May	85	6.34	1.032			
20-May	91	7.44	0.987			
20-May	74	3.81	0.940			
20-May	98	9.36	0.994			
20-May	90	6.71	0.920			
20-May	99	9.76	1.006			
20-May	85	5.94	0.967			
20-May	101	9.4	0.912			
20-May	85	6.49	1.057			
20-May	93	8.01	0.996			
20-May	160	40.15	0.980			
Sample Size	61			4		
Average	93	8.72	1.008	161	36.56	0.872
SD	14.6	5.08	0.056	2.1	2.42	0.045

Appendix 9. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
29-May	107	11.77	0.961			
29-May	88	7.03	1.032			
29-May	95	9.29	1.084			
29-May	104	11.33	1.007			
29-May	82	5.87	1.065			
29-May	110	13.62	1.023			
29-May	85	6.8	1.107			
29-May	90	7.56	1.037			
29-May	97	9.57	1.049			
29-May	90	7.52	1.032			
29-May	106	12.63	1.060			
29-May	98	10.43	1.108			
29-May	82	5.85	1.061			
29-May	86	6.69	1.052			
29-May	103	11.61	1.062			
29-May	93	8.9	1.106			
29-May	94	8.35	1.005			
29-May	89	7.34	1.041			
29-May	97	9.07	0.994			
29-May	103	11.79	1.079			
29-May	84	6.98	1.178			
29-May	110	13.5	1.014			
29-May	92	8.33	1.070			
29-May	112	14.45	1.029			
29-May	111	14.2	1.038			
29-May	94	8.92	1.074			
29-May	98	9.71	1.032			
29-May	99	10.18	1.049			
29-May	83	6.66	1.165			
29-May	104	11.52	1.024			
29-May	88	7.06	1.036			
29-May	91	7.99	1.060			
29-May	93	8.88	1.104			
29-May	82	5.59	1.014			
29-May	112	14	0.996			
29-May	104	10.79	0.959			

Appendix 9. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
29-May	82	5.78	1.048			
29-May	103	11.91	1.090			
Sample Size	38					
Average	96	9.46	1.051			
SD	9.5	2.63	0.046			
12-Jun	97	9.86	1.080			
12-Jun	118	16.65	1.013			
12-Jun	83	6.26	1.095			
12-Jun	99	10.67	1.100			
12-Jun	106	12.35	1.037			
12-Jun	113	14.04	0.973			
12-Jun	103	11.56	1.058			
12-Jun	99	10.09	1.040			
12-Jun	96	9.55	1.079			
12-Jun	115	15.18	0.998			
12-Jun	110	13.06	0.981			
12-Jun	118	16.72	1.018			
12-Jun	85	5.95	0.969			
12-Jun	91	8.6	1.141			
12-Jun	88	8.25	1.211			
12-Jun	84	5.35	0.903			
12-Jun	87	7.15	1.086			
12-Jun	109	13.12	1.013			
12-Jun	109	13.65	1.054			
12-Jun	89	6.52	0.925			
12-Jun	100	10.33	1.033			
12-Jun	101	10.3	1.000			
12-Jun	123	18.85	1.013			
12-Jun	104	11.93	1.061			
12-Jun	104	10.59	0.941			
12-Jun	100	9.7	0.970			
12-Jun	104	12.04	1.070			
12-Jun	91	7.75	1.028			
12-Jun	84	6.16	1.039			
12-Jun	102	11.13	1.049			
12-Jun	109	13.96	1.078			

Appendix 9. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
12-Jun	102	10.79	1.017			
12-Jun	105	12.36	1.068			
Sample Size	33					
Average	101	10.92	1.035			
SD	10.7	3.32	0.061			
Total n	265			45		
Overall Min.	60	2.29	0.820	133	19.03	0.749
Overall Max.	160	40.15	1.371	204	69.85	1.448
Overall Mean	87	7.34	1.018	162	38.32	0.881
Overall SD	14.0	3.92	0.073	15.0	10.53	0.104

Appendix 10. Nose-fork length, weight and condition coefficient (K value), by sample date, for coho and steelhead salmon smolts captured in the upper Capilano River in 2002.

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
28-Mar	70	3.28	0.956			
28-Mar	74	4.06	1.002			
28-Mar	75	4.24	1.005			
28-Mar	72	4.11	1.101			
28-Mar	64	2.79	1.064			
28-Mar	78	4.60	0.969			
28-Mar	76	4.70	1.071			
28-Mar	79	4.81	0.976			
28-Mar	73	4.00	1.028			
28-Mar	63	2.70	1.080			
28-Mar	70	3.53	1.029			
28-Mar	60	2.44	1.130			
28-Mar	73	3.99	1.026			
28-Mar	65	3.09	1.125			
28-Mar	68	3.47	1.104			
28-Mar	71	3.61	1.009			
28-Mar	63	2.57	1.028			
28-Mar	71	3.80	1.062			
28-Mar	60	2.41	1.116			
28-Mar	63	2.47	0.988			
28-Mar	80	5.22	1.020			
28-Mar	81	5.76	1.084			
28-Mar	63	2.37	0.948			
28-Mar	77	4.57	1.001			
28-Mar	68	3.50	1.113			
28-Mar	71	3.38	0.944			
28-Mar	75	4.20	0.996			
28-Mar	65	2.63	0.958			
Sample Size	28					
Average	70	3.65	1.033			
SD	6.2	0.92	0.058			
06-Apr	85	5.25	0.855			
06-Apr	74	3.74	0.923			
06-Apr	71	3.15	0.880			
06-Apr	68	2.92	0.929			

Appendix 10. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
06-Apr	66	2.73	0.950			
06-Apr	65	2.61	0.950			
06-Apr	85	5.31	0.865			
06-Apr	70	3.25	0.948			
06-Apr	68	2.90	0.922			
06-Apr	69	3.10	0.944			
06-Apr	66	2.80	0.974			
06-Apr	67	2.73	0.908			
06-Apr	75	3.64	0.863			
06-Apr	61	2.10	0.925			
06-Apr	71	3.20	0.894			
06-Apr	64	2.29	0.874			
06-Apr	70	3.08	0.898			
06-Apr	64	2.50	0.954			
06-Apr	67	2.99	0.994			
06-Apr	62	2.43	1.020			
06-Apr	69	3.20	0.974			
06-Apr	78	3.91	0.824			
06-Apr	67	2.96	0.984			
06-Apr	69	3.22	0.980			
06-Apr	69	3.12	0.950			
06-Apr	69	2.82	0.858			
06-Apr	64	2.64	1.007			
06-Apr	70	3.22	0.939			
06-Apr	77	4.13	0.905			
06-Apr	71	3.43	0.958			
06-Apr	80	4.65	0.908			
06-Apr	68	2.68	0.852			
06-Apr	58	1.93	0.989			
06-Apr	65	2.63	0.958			
06-Apr	62	2.36	0.990			
06-Apr	66	2.60	0.904			
06-Apr	73	3.89	1.000			
06-Apr	69	3.25	0.989			
06-Apr	63	2.44	0.976			
06-Apr	65	2.56	0.932			
06-Apr	70	3.26	0.950			
06-Apr	70	3.31	0.965			

Appendix 10. (continued)

Date	Coho Nose-Fork Length (mm)	Coho Weight (g)	Coho K Value	Steelhead Nose-Fork Length (mm)	Steelhead Weight (g)	Steelhead K Value
Sample Size	42					
Average	69	3.12	0.935			
SD	5.8	0.73	0.049			
20-Apr	75	4.10	0.972			
20-Apr	67	2.95	0.981			
20-Apr	80	4.95	0.967			
20-Apr	86	6.22	0.978			
20-Apr	74	4.10	1.012			
20-Apr	71	3.27	0.914			
20-Apr	75	3.74	0.887			
20-Apr	76	3.80	0.866			
20-Apr	79	4.48	0.909			
20-Apr	73	3.68	0.946			
20-Apr	73	3.70	0.951			
20-Apr	66	2.61	0.908			
20-Apr	80	4.78	0.934			
20-Apr	64	2.50	0.954			
20-Apr	68	2.88	0.916			
20-Apr	71	3.70	1.034			
20-Apr	64	2.44	0.931			
20-Apr	83	4.98	0.871			
20-Apr	68	2.78	0.884			
20-Apr	69	3.02	0.919			
20-Apr	59	1.95	0.949			
20-Apr	82	5.23	0.949			
20-Apr	72	3.41	0.914			
20-Apr	76	4.33	0.986			
20-Apr	72	3.57	0.956			
20-Apr	70	2.98	0.869			
20-Apr	76	4.41	1.005			
Sample Size	27					
Average	73	3.72	0.939			
SD	6.3	0.99	0.045			
27-Apr	93	7.22	0.898			
27-Apr	86	6.99	1.099			

Appendix 10. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
27-Apr	93	8.11	1.008			
27-Apr	91	7.02	0.932			
27-Apr	76	4.24	0.966			
27-Apr	71	3.68	1.028			
27-Apr	68	2.77	0.881			
27-Apr	75	4.21	0.998			
27-Apr	85	6.31	1.027			
27-Apr	68	2.90	0.922			
27-Apr	70	3.45	1.006			
27-Apr	74	3.98	0.982			
27-Apr	86	6.46	1.016			
27-Apr	74	4.25	1.049			
27-Apr	96	8.83	0.998			
27-Apr	70	3.47	1.012			
27-Apr	75	3.97	0.941			
27-Apr	76	4.67	1.064			
27-Apr	81	5.16	0.971			
27-Apr	73	3.99	1.026			
27-Apr	68	3.22	1.024			
27-Apr	78	4.75	1.001			
27-Apr	88	6.62	0.971			
27-Apr	80	4.92	0.961			
27-Apr	79	4.63	0.939			
27-Apr	75	3.86	0.915			
27-Apr	75	4.44	1.052			
Sample Size	27					
Average	79	4.97	0.988			
SD	8.3	1.64	0.053			
1-3-May				166	40.40	0.883
1-3-May				159	36.05	0.897
1-3-May				165	37.22	0.829
1-3-May				180	48.14	0.825
1-3-May				240	124.43	0.900
1-3-May				158	36.65	0.929
1-3-May				166	39.20	0.857
1-3-May				162	35.76	0.841

Appendix 10. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
1-3-May				175	47.03	0.878
1-3-May				145	29.39	0.964
1-3-May				205	82.03	0.952
1-3-May				174	45.15	0.857
1-3-May				160	34.93	0.853
1-3-May				197	67.92	0.888
1-3-May				152	37.00	1.054
1-3-May				156	30.07	0.792
1-3-May				158	35.93	0.911
1-3-May				163	33.87	0.782
1-3-May				134	21.43	0.891
1-3-May				147	28.80	0.907
1-3-May				155	30.46	0.818
Sample Size				21		
Average				167	43.90	0.881
SD				23.2	22.82	0.062
04-May	89	6.63	0.940			
04-May	74	3.53	0.871			
04-May	74	3.90	0.962			
04-May	78	4.69	0.988			
04-May	70	3.35	0.977			
04-May	66	2.76	0.960			
04-May	66	2.89	1.005			
04-May	76	4.61	1.050			
04-May	74	3.75	0.925			
04-May	90	6.22	0.853			
04-May	67	3.03	1.007			
04-May	68	3.10	0.986			
04-May	61	2.20	0.969			
04-May	74	3.85	0.950			
04-May	93	7.33	0.911			
04-May	68	2.96	0.941			
04-May	82	5.15	0.934			
04-May	118	15.08	0.918			
04-May	93	7.86	0.977			
04-May	69	3.40	1.035			

Appendix 10. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
04-May	79	4.53	0.919			
04-May	71	3.41	0.953			
04-May	73	3.69	0.949			
04-May	74	3.89	0.960			
04-May	70	3.22	0.939			
04-May	79	4.84	0.982			
04-May	66	2.72	0.946			
04-May	68	3.08	0.980			
04-May	59	2.12	1.032			
04-May	73	3.93	1.010			
04-May	71	3.37	0.942			
04-May	78	4.35	0.917			
04-May	75	3.85	0.913			
Sample Size	33					
Average	75	4.34	0.958			
SD	11.3	2.35	0.044			
5-6-May				167	42.61	0.915
5-6-May				161	37.80	0.906
5-6-May				165	37.10	0.826
Sample Size				3		
Average				164	39.17	0.882
SD				3.1	3.00	0.049
12-May	107	10.26	0.838	165	38.97	0.868
12-May	116	13.84	0.887	158	32.52	0.824
12-May	102	11.81	1.113	115	12.12	0.797
12-May	85	6.16	1.003	142	24.92	0.870
12-May	74	4.23	1.044	141	24.70	0.881
12-May	104	10.64	0.946	161	34.36	0.823
12-May	74	3.93	0.970	165	36.95	0.823
12-May	89	6.15	0.872	159	35.05	0.872
12-May	77	4.06	0.889	180	46.72	0.801
12-May	96	8.55	0.966	147	29.11	0.916
12-May	87	6.27	0.952	153	29.90	0.835
12-May	75	3.96	0.939	138	23.98	0.912

Appendix 10. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
12-May	69	2.78	0.846	162	35.82	0.843
12-May	80	5.07	0.990	196	70.06	0.930
12-May	85	5.53	0.900	173	46.43	0.897
12-May	85	5.57	0.907	147	27.95	0.880
12-May	71	3.39	0.947	165	36.35	0.809
12-May	84	5.30	0.894	165	38.62	0.860
12-May	84	5.83	0.984	182	52.42	0.870
12-May	85	5.97	0.972	153	31.96	0.892
12-May	74	3.81	0.940	158	32.92	0.835
12-May	64	2.51	0.957	158	32.70	0.829
12-May	66	2.97	1.033			
12-May	72	3.63	0.973			
12-May	89	5.91	0.838			
12-May	71	3.32	0.928			
12-May	85	5.42	0.883			
12-May	75	3.87	0.917			
12-May	97	8.60	0.942			
12-May	70	3.24	0.945			
12-May	72	3.64	0.975			
12-May	79	4.82	0.978			
12-May	75	3.93	0.932			
Sample Size	33			22		
Average	82	5.61	0.942	158	35.21	0.858
SD	12.5	2.74	0.059	17.0	11.60	0.038
18-May	85	5.74	0.935			
18-May	82	5.48	0.994			
18-May	79	4.58	0.929			
18-May	76	4.38	0.998			
18-May	86	6.65	1.046			
18-May	71	3.50	0.978			
18-May	93	7.43	0.924			
18-May	78	4.96	1.045			
18-May	76	4.45	1.014			
18-May	80	4.92	0.961			
18-May	87	6.27	0.952			
18-May	84	5.93	1.000			

Appendix 10. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
18-May	86	7.45	1.171			
18-May	80	5.55	1.084			
18-May	73	4.19	1.077			
18-May	66	3.10	1.078			
18-May	91	7.03	0.933			
18-May	70	3.37	0.983			
18-May	95	7.88	0.919			
18-May	86	6.09	0.957			
18-May	96	7.95	0.899			
18-May	108	11.96	0.949			
18-May	70	3.65	1.064			
18-May	97	9.25	1.014			
18-May	95	9.01	1.051			
18-May	85	6.31	1.027			
18-May	64	2.63	1.003			
18-May	85	6.24	1.016			
18-May	96	9.23	1.043			
18-May	84	5.24	0.884			
18-May	98	8.85	0.940			
18-May	85	6.80	1.107			
18-May	85	5.70	0.928			
18-May	84	5.65	0.953			
18-May	87	5.56	0.844			
18-May	72	3.90	1.045			
Sample Size	36					
Average	84	6.02	0.993			
SD	9.9	2.03	0.069			
27-May	84	6.10	1.029	155	34.27	0.920
27-May	98	8.62	0.916	153	29.52	0.824
27-May	77	4.45	0.975	161	33.83	0.811
27-May	81	5.57	1.048	171	40.12	0.802
27-May	82	5.34	0.969	168	40.35	0.851
27-May	96	9.54	1.078	184	51.87	0.833
27-May	72	3.71	0.994	153	31.21	0.871
27-May	85	6.31	1.027	170	46.06	0.938
27-May	81	5.01	0.943	154	29.86	0.818

Appendix 10. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
27-May	74	3.85	0.950	147	26.72	0.841
27-May	79	4.57	0.927	164	37.22	0.844
27-May	75	4.13	0.979			
27-May	98	8.75	0.930			
27-May	88	7.06	1.036			
27-May	101	10.11	0.981			
27-May	95	8.33	0.972			
27-May	68	3.17	1.008			
27-May	84	4.93	0.832			
27-May	86	5.86	0.921			
27-May	80	5.26	1.027			
27-May	75	3.91	0.927			
27-May	88	6.37	0.935			
27-May	82	5.62	1.019			
27-May	84	5.95	1.004			
27-May	96	8.13	0.919			
27-May	89	6.86	0.973			
27-May	99	9.24	0.952			
27-May	80	5.34	1.043			
27-May	86	6.48	1.019			
27-May	83	5.36	0.937			
27-May	85	6.24	1.016			
27-May	105	10.49	0.906			
27-May	75	4.07	0.965			
27-May	85	6.25	1.018			
27-May	86	6.01	0.945			
27-May	76	4.11	0.936			
Sample Size	36			11		
Average	85	6.14	0.974	162	36.46	0.850
SD	8.8	1.91	0.051	10.8	7.65	0.044
02-Jun	79	5.34	1.083			
02-Jun	89	6.95	0.986			
02-Jun	95	8.54	0.996			
02-Jun	92	7.93	1.018			
02-Jun	96	8.77	0.991			
02-Jun	103	10.52	0.963			

Appendix 10. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
02-Jun	93	7.15	0.889			
02-Jun	86	6.19	0.973			
02-Jun	76	4.51	1.027			
02-Jun	90	6.92	0.949			
02-Jun	81	5.61	1.056			
02-Jun	94	8.38	1.009			
02-Jun	72	3.59	0.962			
02-Jun	90	6.87	0.942			
02-Jun	73	4.03	1.036			
02-Jun	97	8.41	0.921			
02-Jun	81	5.31	0.999			
02-Jun	80	5.18	1.012			
02-Jun	90	7.82	1.073			
02-Jun	78	5.25	1.106			
02-Jun	83	5.90	1.032			
02-Jun	98	9.69	1.030			
02-Jun	79	4.97	1.008			
02-Jun	69	3.49	1.062			
02-Jun	87	6.80	1.033			
02-Jun	85	6.23	1.014			
02-Jun	78	4.78	1.007			
02-Jun	79	4.89	0.992			
02-Jun	95	9.93	1.158			
02-Jun	91	7.75	1.028			
02-Jun	75	3.82	0.905			
02-Jun	84	6.14	1.036			
02-Jun	74	4.18	1.032			
02-Jun	89	6.67	0.946			
Sample Size	34					
Average	85	6.43	1.008			
SD	8.6	1.88	0.056			
09-Jun	85	6.32	1.029			
09-Jun	102	9.99	0.941			
09-Jun	116	14.72	0.943			
09-Jun	113	13.13	0.910			
09-Jun	120	14.80	0.856			

Appendix 10. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
09-Jun	152	30.69	0.874			
09-Jun	112	11.90	0.847			
09-Jun	75	4.05	0.960			
09-Jun	92	7.19	0.923			
09-Jun	127	16.53	0.807			
09-Jun	86	6.24	0.981			
09-Jun	83	5.94	1.039			
09-Jun	76	4.69	1.068			
09-Jun	80	5.22	1.020			
09-Jun	82	5.68	1.030			
09-Jun	90	7.98	1.095			
09-Jun	109	11.37	0.878			
09-Jun	89	7.42	1.053			
09-Jun	78	5.04	1.062			
09-Jun	75	4.72	1.119			
09-Jun	81	4.91	0.924			
09-Jun	79	5.35	1.085			
09-Jun	87	6.73	1.022			
09-Jun	83	5.63	0.985			
09-Jun	118	14.37	0.875			
09-Jun	100	10.20	1.020			
09-Jun	114	13.34	0.900			
09-Jun	80	5.08	0.992			
09-Jun	89	6.75	0.957			
09-Jun	84	5.52	0.931			
09-Jun	80	5.52	1.078			
09-Jun	75	4.33	1.026			
09-Jun	91	7.48	0.993			
09-Jun	91	7.02	0.932			
09-Jun	85	6.21	1.011			
09-Jun	109	11.66	0.900			
09-Jun	117	14.45	0.902			
09-Jun	125	17.32	0.887			
09-Jun	125	17.96	0.920			
09-Jun	120	15.38	0.890			
09-Jun	117	13.90	0.868			
09-Jun	92	7.96	1.022			
09-Jun	121	14.91	0.842			

Appendix 10. (continued)

	Coho			Steelhead		
Date	Nose-Fork Length (mm)	Weight (g)	K Value	Nose-Fork Length (mm)	Weight (g)	K Value
09-Jun	85	6.22	1.013			
09-Jun	76	4.39	1.000			
09-Jun	87	6.77	1.028			
09-Jun	88	6.72	0.986			
09-Jun	79	5.14	1.043			
09-Jun	113	12.47	0.864			
09-Jun	122	14.69	0.809			
09-Jun	134	19.63	0.816			
09-Jun	136	22.85	0.908			
09-Jun	119	15.55	0.923			
09-Jun	87	6.27	0.952			
09-Jun	110	12.32	0.926			
09-Jun	118	13.94	0.848			
09-Jun	78	4.63	0.976			
09-Jun	82	5.33	0.967			
09-Jun	81	5.82	1.095			
09-Jun	89	7.50	1.064			
09-Jun	85	6.56	1.068			
09-Jun	81	5.45	1.026			
09-Jun	79	5.32	1.079			
09-Jun	90	8.01	1.099			
09-Jun	84	5.92	0.999			
09-Jun	78	4.66	0.982			
09-Jun	81	5.48	1.031			
09-Jun	66	2.98	1.037			
09-Jun	78	4.91	1.035			
09-Jun	127	17.34	0.847			
Sample Size	70					
Average	96	9.32	0.969			
SD	19.3	5.31	0.081			
Total n	366			57		
Overall Min.	58	1.93	0.807	115	12.12	0.782
Overall Max.	152	30.69	1.171	240	124.43	1.054
Overall Mean	82	5.75	0.972	163	38.86	0.866
Overall SD	14.7	3.48	0.066	18.4	16.22	0.050

Appendix 11. Summary, by date, of the coho salmon smolt mark recapture study conducted on the upper Capilano River in 2001.

Date Marked	Mark Type	Marked Smolts Released	Date Recovered	Marked Smolts Recaptured: Lakehead Bridge	Marked Smolts Recaptured: Lake Inlet	Marked Smolts Recaptured: Total	Unmarked Smolt Catch: Lakehead Bridge	Unmarked Smolt Catch: Lake Inlet	Unmarked Smolt Catch: Total
			20-Mar. to 09-Apr.	0	0	0	315	107	422
09-Apr	anal dye	76	10-Apr	2	0	2	6	0	6
			11-Apr	2	0	2	14	0	14
			12-Apr	0	0	0	7	0	7
			13-Apr	0	0	0	0	0	0
			14-Apr	0	0	0	0	0	0
			15-Apr	0	0	0	0	0	0
			16-Apr	0	0	0	0	0	0
			17-Apr	0	1	1	24	14	38
			18-Apr	0	0	0	110	103	213
			19-Apr	0	0	0	111	83	194
			20-Apr	0	0	0	85	33	118
			21-Apr	0	0	0	62	18	80
			22-Apr	1	0	1	83	25	108
Total				5	1	6	817	383	1,200
Marked Smolt Incidence (%)							0.6	0.3	0.5
Marked Smolt Recovery Rate (%)				6.6	1.3	7.9			
19-Apr	anal dye plus upper caudal clip	100	20-Apr	4	0	4	85	33	118
			21-Apr	0	0	0	62	18	80
			22-Apr	4	1	5	83	25	108
			23-Apr	1	0	1	98	48	146
			24-Apr	1	1	2	93	94	187
			25-Apr	0	0	0	238	142	380
			26-Apr	0	0	0	228	127	355
			27-Apr	0	0	0	174	101	275
			28-Apr	0	0	0	82	45	127
			29-Apr	0	0	0	44	44	88
			30-Apr	0	1	1	57	43	100
Total				10	3	13	1,244	720	1,964
Marked Smolt Incidence (%)							0.8	0.4	0.7
Marked Smolt Recovery Rate (%)				10.0	3.0	13.0			

Appendix 11. (continued)

Date Marked	Mark Type	Marked Smolts Released	Date Recovered	Marked Smolts Recaptured: Lakehead Bridge	Marked Smolts Recaptured: Lake Inlet	Marked Smolts Recaptured: Total	Unmarked Smolt Catch: Lakehead Bridge	Unmarked Smolt Catch: Lake Inlet	Unmarked Smolt Catch: Total
26-Apr	anal	108	27-Apr	2	0	2	174	101	275
	dye		28-Apr	0	0	0	82	45	127
	plus		29-Apr	0	0	0	44	44	88
	lower		30-Apr	0	0	0	57	43	100
	caudal		01-May	0	0	0	69	35	104
	clip		02-May	0	0	0	73	24	97
			03-May	1	0	1	42	16	58
			04-May	0	0	0	21	9	30
			05-May	0	0	0	144	101	245
			06-May	0	0	0	108	33	141
			07-May	1	0	1	44	12	56
Total				4	0	4	858	463	1,321
Marked Smolt Incidence (%)							0.5	0.0	0.3
Marked Smolt Recovery Rate (%)				3.7	0.0	3.7			
02-May	caudal	90	03-May	4	0	4	42	16	58
	dye		04-May	6	0	6	21	9	30
	plus		05-May	1	0	1	144	101	245
	upper		06-May	0	0	0	108	33	141
	caudal		07-May	0	0	0	44	12	56
	clip		08-May	0	0	0	70	12	82
			09-May	0	0	0	112	32	144
Total				11	0	11	541	215	756
Marked Smolt Incidence (%)							2.0	0.0	1.4
Marked Smolt Recovery Rate (%)				12.2	0.0	12.2			
09-May	dorsal	100	10-May	14	2	16	128	27	155
	dye		11-May	1	1	2	65	20	85
			12-May	1	0	1	206	67	273
			13-May	0	2	2	278	126	404
			14-May	0	0	0	187	31	218
			15-May	0	0	0	0	0	0
			16-May	0	0	0	0	63	63
			17-May	0	0	0	0	41	41

Appendix 11. (continued)

Date Marked	Mark Type	Marked Smolts Released	Date Recovered	Marked Smolts Recaptured: Lakehead Bridge	Marked Smolts Recaptured: Lake Inlet	Marked Smolts Recaptured: Total	Unmarked Smolt Catch: Lakehead Bridge	Unmarked Smolt Catch: Lake Inlet	Unmarked Smolt Catch: Total
			18-May	0	0	0	0	16	16
			19-May	0	0	0	0	9	9
			20-May	0	0	0	60	9	69
			21-May	0	0	0	35	2	37
			22-May	0	0	0	116	29	145
Total				16	5	21	1,075	440	1,515
Marked Smolt Incidence (%)							1.5	1.1	1.4
Marked Smolt Recovery Rate (%)				16.0	5.0	21.0			
22-May	dorsal dye	100	23-May	11	4	15	213	53	266
			24-May	0	0	0	122	35	157
			25-May	0	0	0	87	29	116
			26-May	0	0	0	47	13	60
			27-May	0	0	0	37	6	43
			28-May	0	0	0	26	3	29
			29-May	0	0	0	36	6	42
			30-May	0	0	0	47	0	47
			31-May	0	0	0	31	0	31
			01-Jun	0	0	0	44	0	44
			02-Jun	0	0	0	48	0	48
			03-Jun	0	0	0	23	0	23
			04-Jun	0	0	0	38	0	38
			05-Jun	0	0	0	12	0	12
			06-Jun	0	0	0	13	0	13
			07-Jun	0	0	0	30	0	30
			08-Jun	0	0	0	37	0	37
			09-Jun	0	0	0	75	0	75
Total				11	4	15	966	145	1,111
Marked Smolt Incidence (%)							1.1	2.7	1.3
Marked Smolt Recovery Rate (%)				11.0	4.0	15.0			

Appendix 11. (continued)

Date Marked	Mark Type	Marked Smolts Released	Date Recovered	Marked Smolts Recaptured			Unmarked Smolt Catch		
				Lakehead Bridge	Lake Inlet	Total	Lakehead Bridge	Lake Inlet	Total
09-Jun	dorsal dye plus lower caudal clip	96	10-Jun	10	0	10	42	0	42
			11-Jun	4	0	4	11	0	11
			12-Jun	4	0	4	34	0	34
			13-Jun	1	0	1	11	0	11
Total				19	0	19	98	0	98
Marked Smolt Incidence (%)							16.2	0.0	16.2
Marked Smolt Recovery Rate (%)				19.8	0.0	19.8			

Appendix 12. Summary, by date, of the coho salmon smolt mark recapture study conducted on the upper Capilano River in 2002.

Date Marked	Mark Type	Marked Smolts Released	Date Recovered	Marked Smolts Recaptured (all traps)	Unmarked Smolt Catch (all traps)
	no mark		20-Mar. to 06-Apr.	0	634
06-Apr	upper caudal clip	110	07-Apr.	39	391
			08-Apr.	1	397
			09-Apr.	0	248
			10-Apr.	0	391
			11-Apr.	0	396
			12-Apr.	0	0
			13-Apr.	0	0
			14-Apr.	0	0
			15-Apr.	0	0
			16-Apr.	0	109
			17-Apr.	0	177
			18-Apr.	0	183
			19-Apr.	0	276
Total				40	3,202
Marked Smolt Incidence (%)					1.2
Marked Smolt Recovery Rate (%)				36.4	
19-Apr	lower caudal clip	105	20-Apr.	23	280
			21-Apr.	8	246
			22-Apr.	0	183
			23-Apr	0	203
			24-Apr	0	111
			25-Apr	0	64
			26-Apr	0	59
			27-Apr	0	59
			28-Apr	0	126
Total				31	1,331
Marked Smolt Incidence (%)					2.3
Marked Smolt Recovery Rate (%)				29.5	

Appendix 12. (continued)

Date Marked	Mark Type	Marked Smolts Released	Date Recovered	Marked Smolts Recaptured (all traps)	Unmarked Smolt Catch (all traps)
28-Apr	left ventral clip	124	29-Apr	37	126
			30-Apr	2	349
			01-May	0	423
			02-May	0	446
			03-May	0	225
			04-May	0	157
Total				39	1,726
Marked Smolt Incidence (%)					2.2
Marked Smolt Recovery Rate (%)				31.5	
04-May	caudal dye	105	05-May	14	104
			06-May	20	302
			07-May	0	273
			08-May	0	330
			09-May	0	174
			10-May	0	85
			11-May	0	94
Total				34	1,362
Marked Smolt Incidence (%)					2.4
Marked Smolt Recovery Rate (%)				32.4	
11-May	caudal dye upper caudal clip	97	12-May	33	504
			13-May	3	1,296
			14-May	1	297
Total				37	2,097
Marked Smolt Incidence (%)					1.7
Marked Smolt Recovery Rate (%)				38.1	

Appendix 12. (continued)

Date Marked	Mark Type	Marked Smolts Released	Date Recovered	Marked Smolts Recaptured (all traps)	Unmarked Smolt Catch (all traps)
14-May	anal dye	100	15-May	37	762
	upper		16-May	4	455
	caudal clip		17-May	0	523
			18-May	0	418
Total				41	2,158
Marked Smolt Incidence (%)					1.9
Marked Smolt Recovery Rate (%)				41.0	
18-May	anal dye	100	19-May	31	400
	lower		20-May	6	344
	caudal clip		21-May	1	316
			22-May	1	392
			23-May	1	423
			24-May	1	390
Total				41	2,265
Marked Smolt Incidence (%)					1.8
Marked Smolt Recovery Rate (%)				41.0	
23-May	dorsal dye	90	24-May	26	390
	upper		25-May	9	360
	caudal clip		26-May	2	458
			27-May	1	482
			28-May	0	267
			29-May	0	7
			30-May	0	184
Total				38	2,148
Marked Smolt Incidence (%)					1.7
Marked Smolt Recovery Rate (%)				42.2	

Appendix 12. (continued)

Date Marked	Mark Type	Marked Smolts Released	Date Recovered	Marked Smolts Recaptured (all traps)	Unmarked Smolt Catch (all traps)
30-May	dorsal dye only	48	31-May	39	574
	upper caudal clip only	50	01-Jun	3	306
			02-Jun	1	218
			03-Jun	1	221
Total				44	1,319
Marked Smolt Incidence (%)					3.2
Marked Smolt Recovery Rate (%)				44.9	
03-Jun	dorsal and anal dye	89	04-Jun	21	171
			05-Jun	7	93
			06-Jun	0	64
Total				28	328
Marked Smolt Incidence (%)					7.9
Marked Smolt Recovery Rate (%)				31.5	
06-Jun	lower caudal clip	63	07-Jun	26	68
			08-Jun	0	34
			09-Jun	1	70
			10-Jun	0	65
			11-Jun	0	43
			12-Jun	0	22
			13-Jun	0	17
Total				27	319
Marked Smolt Incidence (%)					7.8
Marked Smolt Recovery Rate (%)				42.9	

Appendix 13. Daily catch, by condition factor, of coho salmon smolts in the RST deployed below the Cleveland Dam spillway in the lower Capilano River in 2001.

Date	Spillway Discharge (cfs)	Condition Factor					Total
		A	B	C	D	E	
21-Mar		1	0	0	1	0	2
01-Apr	239	0	0	0	0	1	1
18-Apr	498	0	0	0	0	1	1
19-Apr	342	1	0	0	0	1	2
21-Apr	188	0	1	0	0	2	3
22-Apr	241	0	0	0	0	1	1
23-Apr	614	1	1	0	0	0	2
24-Apr	875	0	7	1	0	10	18
25-Apr	1,004	4	7	2	0	12	25
26-Apr	924	0	7	0	0	22	29
27-Apr	883	0	7	0	0	14	21
28-Apr	998	8	1	0	0	10	19
29-Apr	946	5	5	4	2	12	28
30-Apr	994	11	8	5	1	22	47
01-May	886	13	3	0	0	24	40
02-May	526	5	2	3	1	14	25
03-May	296	2	3	0	4	8	17
04-May	269	1	2	1	0	1	5
05-May	854	1	3	2	1	30	37
06-May	436	1	4	4	1	7	17
07-May	276	3	5	0	0	5	13
08-May	252	0	2	3	1	4	10
09-May	272	1	7	15	2	23	48
10-May	245	3	10	8	0	17	38
11-May	4	3	7	2	0	6	18
12-May	0	0	4	0	0	1	5
13-May	5	0	0	0	0	0	0
14-May	1,565	0	4	11	5	174	194
15-May	1,514	0	2	3	4	17	26
16-May	1,326	17	41	66	121	354	599
17-May	738	0	4	34	2	138	178
18-May	412	4	7	5	4	34	54
19-May	287	4	11	8	1	4	28
20-May	299	2	2	1	3	13	21
21-May	230	11	27	30	11	23	102

Appendix 13. (continued)

Date	Spillway Discharge (cfs)	Condition Factor A	B	C	D	E	Total
22-May	318	5	5	3	8	50	71
23-May	768	38	34	25	4	101	202
24-May	942	14	17	10	2	91	134
25-May	750	23	16	4	6	18	67
26-May	648	12	14	5	1	12	44
27-May	580	5	6	6	1	9	27
28-May	567	7	12	8	1	3	31
29-May	305	14	16	17	7	31	85
30-May	14	4	2	1	0	2	9
31-May	1	0	0	0	0	0	0
01-Jun	320	4	1	2	0	2	9
02-Jun	185	1	3	2	0	93	99
03-Jun	159	7	3	2	2	0	14
04-Jun	104	0	0	1	0	1	2
05-Jun	101	1	0	0	0	0	1
06-Jun	136	0	2	1	0	0	3
07-Jun	31	0	1	1	1	0	3
08-Jun	16	2	4	5	2	1	14
09-Jun	155	3	1	1	0	0	5
10-Jun	198	0	0	0	3	4	7
11-Jun	119	2	2	2	2	0	8
12-Jun	143	2	0	0	1	0	3
13-Jun	59	1	1	0	1	2	5
14-Jun	2	7	4	3	4	2	20
Total		254	338	307	211	1,427	2,537

Condition Factors:

A - Excellent - fish is lively; no scale loss or bruising; no obvious stress.

B - Good - a few scales lost but still very much alive; little or no obvious stress.

C - Satisfactory - fish has noticeable scale loss, a little bruising and visible signs of stress.

D - Poor - fish is moribund, lots of scale loss and bruising, highly stressed.

E – Dead.

Appendix 14. Daily catch, by condition factor, of steelhead salmon smolts in the RST deployed below the Cleveland Dam spillway in the lower Capilano River in 2001.

Date	Spillway Discharge (cfs)	Condition Factor					Total
		A	B	C	D	E	
24-Apr	875	1	0	0	0	1	2
25-Apr	1,004	0	1	0	0	0	1
28-Apr	998	1	0	0	0	0	1
29-Apr	946	1	0	0	0	0	1
30-Apr	994	0	1	0	0	0	1
05-May	854	0	1	0	0	0	1
06-May	436	0	1	0	0	0	1
16-May	1,326	0	3	0	1	0	4
17-May	738	0	0	0	0	1	1
18-May	412	0	0	0	0	1	1
23-May	768	0	1	1	0	1	3
24-May	942	1	0	1	0	1	3
25-May	750	1	0	0	0	0	1
06-Jun	136	0	0	1	0	0	1
09-Jun	155	0	1	0	0	0	1
11-Jun	119	0	2	0	1	0	3
Total		5	11	3	2	5	26

Condition Factors:

A - Excellent - fish is lively; no scale loss or bruising; no obvious stress.

B - Good - a few scales lost but still very much alive; little or no obvious stress.

C - Satisfactory - fish has noticeable scale loss, a little bruising and visible signs of stress.

D - Poor - fish is moribund, lots of scale loss and bruising, highly stressed.

E – Dead.

Appendix 15. Daily discharge and other related parameters of the Capilano Reservoir and Cleveland Dam in 2001. Data are from the Greater Vancouver Water District.

Date	Average Reservoir Elevation (ft)	Average Drum Gate Elevation (ft)	Average Head Over Crest (ft)	Spillway Flow (cfs)	Lower Outlet Works (cfs)	Upper Outlet Works (cfs)	Turbine & Fish Trap (cfs)	Intake Flow (cfs)	Total Reservoir Flow (cfs)	Down Flow (cfs)
01-Apr	567.79	566.64	1.15	239	0	0	20	228	487	239
02-Apr	567.72	566.89	0.83	141	0	0	20	238	399	141
03-Apr	567.71	567.20	0.51	64	0	0	20	236	321	64
04-Apr	567.66	567.32	0.34	25	0	0	20	216	261	25
05-Apr	567.79	567.22	0.57	16	0	0	20	162	198	16
06-Apr	567.76	567.18	0.58	44	0	0	20	149	212	44
07-Apr	567.74	567.26	0.49	48	0	0	20	136	204	48
08-Apr	567.71	567.31	0.40	42	0	0	20	142	204	42
09-Apr	567.74	567.33	0.41	21	0	0	20	150	190	21
10-Apr	567.76	567.31	0.44	10	0	0	20	155	184	10
11-Apr	567.66	567.40	0.26	15	0	0	20	146	181	15
12-Apr	567.73	567.46	0.27	2	0	0	20	157	179	2
13-Apr	567.70	567.42	0.28	12	0	0	20	118	151	12
14-Apr	567.67	567.48	0.19	5	0	0	20	141	166	5
15-Apr	567.62	567.54	0.08	0	0	0	20	141	161	0
16-Apr	567.72	567.56	0.16	0	0	0	20	165	185	0
17-Apr	567.85	566.60	1.25	303	0	0	20	163	486	303
18-Apr	567.88	566.12	1.76	498	0	0	20	162	680	498
19-Apr	567.84	566.39	1.45	342	0	0	20	172	534	342
20-Apr	567.73	566.75	0.97	192	0	0	20	172	384	192
21-Apr	567.73	566.81	0.92	188	0	0	20	162	370	188
22-Apr	567.84	566.72	1.12	241	0	0	20	161	422	241
23-Apr	567.95	565.98	1.97	614	0	0	20	156	790	614
24-Apr	568.01	565.54	2.46	875	0	0	20	161	1,056	875
25-Apr	567.94	565.25	2.69	1,004	0	0	20	159	1,183	1,004
26-Apr	567.96	565.37	2.58	924	0	0	20	156	1,100	924
27-Apr	567.98	565.43	2.55	883	0	0	20	154	1,057	883
28-Apr	567.95	565.33	2.62	998	0	0	20	145	1,163	998
29-Apr	567.99	565.43	2.56	946	0	0	20	143	1,108	946
30-Apr	567.99	565.34	2.65	994	0	0	20	153	1,168	994
01-May	567.93	565.62	2.30	886	0	0	20	159	1,065	886
02-May	567.82	566.19	1.63	526	0	0	20	156	702	526
03-May	567.86	566.48	1.38	296	0	0	20	156	472	296
04-May	567.89	566.44	1.45	269	0	0	20	158	447	269
05-May	567.89	565.65	2.25	854	0	0	20	149	1,024	854
06-May	567.81	566.27	1.54	436	0	0	20	152	608	436

Appendix 15. (continued)

Date	Average Reservoir Elevation (ft)	Average Drum Gate Elevation (ft)	Average Head Over Crest (ft)	Spillway Flow (cfs)	Lower Outlet Works (cfs)	Upper Outlet Works (cfs)	Turbine & Fish Trap (cfs)	Intake Flow (cfs)	Total Reservoir Flow (cfs)	Down Flow (cfs)
07-May	567.81	566.56	1.25	276	0	0	20	157	453	276
08-May	567.79	566.59	1.20	252	0	0	20	162	434	252
09-May	567.80	566.54	1.26	272	0	0	20	165	457	272
10-May	567.78	566.64	1.14	245	37	0	20	166	468	282
11-May	567.49	569.19	-1.69	4	430	0	20	165	619	434
12-May	568.18	570.30	-2.12	0	155	0	20	152	326	155
13-May	569.77	570.13	-0.37	5	155	0	20	154	335	160
14-May	570.53	567.21	3.32	1,565	81	0	20	159	1,825	1,646
15-May	570.48	567.18	3.30	1,514	0	0	20	215	1,749	1,514
16-May	570.46	567.48	2.98	1,326	0	0	20	165	1,512	1,326
17-May	570.37	568.19	2.18	738	0	0	20	151	909	738
18-May	570.28	568.76	1.52	412	0	0	20	163	595	412
19-May	570.28	568.99	1.29	287	0	0	20	154	461	287
20-May	570.22	569.01	1.21	299	0	0	20	142	461	299
21-May	570.21	569.05	1.15	230	0	0	20	165	415	230
22-May	570.25	568.82	1.44	318	0	0	20	167	505	318
23-May	570.33	568.09	2.25	768	0	0	20	169	957	768
24-May	570.36	567.92	2.44	942	0	0	20	171	1,133	942
25-May	570.33	568.14	2.18	750	0	0	20	177	948	750
26-May	570.33	568.23	2.10	648	0	0	20	180	848	648
27-May	570.33	568.40	1.94	580	0	0	20	164	764	580
28-May	570.34	568.51	1.83	[illegible]	0	0	20	166	753	567
29-May	570.27	569.10	1.17	305	19	0	20	171	514	324
30-May	569.99	570.06	-0.07	14	417	0	20	161	612	431
31-May	569.97	570.13	-0.16	1	172	0	20	176	369	173
01-Jun	570.29	568.98	1.32	320	9	0	20	162	512	330
02-Jun	570.23	569.24	0.99	185	111	0	20	152	468	296
03-Jun	570.25	569.35	0.90	159	0	0	20	157	336	159
04-Jun	570.24	569.39	0.85	104	251	0	20	165	540	356
05-Jun	570.21	569.46	0.76	101	227	0	20	164	513	329
06-Jun	570.22	569.40	0.82	136	226	0	20	170	552	362
07-Jun	570.18	569.69	0.49	31	222	0	20	163	437	253
08-Jun	569.95	569.51	0.44	16	226	0	20	170	432	242
09-Jun	570.10	569.23	0.87	155	223	0	20	162	561	378
10-Jun	570.11	569.01	1.10	198	222	0	20	145	585	421
11-Jun	569.92	569.04	0.88	119	224	0	20	166	529	343
12-Jun	570.17	569.31	0.85	143	222	0	20	152	538	366

Appendix 15. (continued)

Date	Average Reservoir Elevation (ft)	Average Drum Gate Elevation (ft)	Average Head Over Crest (ft)	Spillway Flow (cfs)	Lower Outlet Works (cfs)	Upper Outlet Works (cfs)	Turbine & Fish Trap (cfs)	Intake Flow (cfs)	Total Reservoir Flow (cfs)	Down Flow (cfs)
12-Jun	570.17	569.31	0.85	143	222	0	20	152	538	366
13-Jun	570.09	569.55	0.54	59	222	0	20	173	474	281
14-Jun	569.83	569.57	0.26	2	131	0	20	166	320	133
15-Jun	569.83	569.74	0.09	1	0	0	20	175	196	1
16-Jun	570.04	569.84	0.20	12	0	0	20	159	190	12
17-Jun	570.13	569.85	0.28	6	0	0	20	172	198	6
18-Jun	570.13	569.85	0.28	12	0	0	20	177	209	12
19-Jun	570.12	569.81	0.31	10	0	0	20	182	212	10
20-Jun	570.15	569.67	0.48	38	1	0	20	198	257	38
21-Jun	570.15	569.66	0.49	27	0	0	20	200	248	27
22-Jun	570.18	569.58	0.61	49	0	0	20	181	250	49
23-Jun	570.15	569.73	0.42	22	0	0	20	181	223	22
24-Jun	570.15	569.85	0.30	7	0	0	20	172	198	7
25-Jun	570.17	569.77	0.40	20	0	0	20	178	218	20
26-Jun	563.75	569.89	-6.14	4	0	0	20	177	202	4
27-Jun	567.49	569.71	-2.22	41	0	0	20	167	228	41
28-Jun	569.98	569.11	0.87	293	0	0	20	174	487	293
29-Jun	570.04	569.26	0.78	173	0	0	20	176	369	173
30-Jun	569.90	569.52	0.38	74	0	0	20	183	277	74
Min.	563.75	565.25	-6.14	0	0	0	20	118	151	0
Max.	570.53	570.30	3.32	1,565	430	0	20	238	1,825	1,646
Mean	568.98	568.03	0.95	305	44	0	20	166	535	349
SD	1.31	1.50	1.27	372	95	0	0	20	359	360

Appendix 16. Biological sampling data collected from coho salmon smolts captured below the Cleveland Dam spillway in 2001.

Date	Nose-Fork Length (mm)	Weight (g)	K Value	Condition Factor
21-May	75	4.89	1.159	A
21-May	84	6.05	1.021	C
21-May	82	6.10	1.106	A
21-May	84	6.21	1.048	A
21-May	83	6.30	1.102	B
21-May	87	6.39	0.970	C
21-May	86	6.43	1.011	B
21-May	88	7.00	1.027	B
21-May	87	7.03	1.068	B
21-May	88	7.12	1.045	B
21-May	90	7.15	0.981	C
21-May	92	7.64	0.981	C
21-May	92	7.89	1.013	B
21-May	91	8.00	1.062	A
21-May	96	9.22	1.042	A
21-May	98	9.22	0.980	C
21-May	99	9.44	0.973	A
21-May	103	10.55	0.965	B
21-May	102	10.78	1.016	C
21-May	102	11.06	1.042	B
21-May	104	11.27	1.002	C
21-May	103	11.51	1.053	B
21-May	104	11.62	1.033	C
21-May	117	11.94	0.745	B
21-May	105	11.99	1.036	B
21-May	100	12.24	1.224	D
21-May	108	12.28	0.975	B
21-May	107	12.62	1.030	D
21-May	110	12.84	0.965	B
21-May	110	13.54	1.017	A
21-May	115	13.58	0.893	D
21-May	112	13.97	0.994	D
21-May	114	14.06	0.949	C
21-May	112	14.10	1.004	A
21-May	112	14.42	1.026	D
21-May	113	14.45	1.001	C
21-May	112	14.91	1.061	C
21-May	113	14.93	1.035	C
21-May	115	15.04	0.989	B

Appendix 16. (continued)

Date	Nose-Fork Length (mm)	Weight (g)	K Value	Condition Factor
21-May	116	15.34	0.983	C
21-May	115	15.40	1.013	C
21-May	126	15.62	0.781	C
21-May	117	15.62	0.975	C
21-May	118	15.73	0.957	A
21-May	114	15.76	1.064	C
21-May	119	15.78	0.936	C
21-May	119	15.90	0.944	D
21-May	114	15.99	1.079	C
21-May	119	16.75	0.994	A
21-May	118	16.81	1.023	B
21-May	118	17.21	1.047	B
21-May	122	17.27	0.951	D
21-May	125	17.98	0.921	B
21-May	122	18.22	1.003	C
21-May	124	18.32	0.961	B
21-May	123	18.69	1.004	B
21-May	124	18.77	0.984	A
21-May	122	19.14	1.054	C
21-May	126	19.53	0.976	D
21-May	125	19.54	1.000	C
21-May	128	19.66	0.937	B
21-May	125	19.76	1.012	C
21-May	125	19.83	1.015	C
21-May	124	20.13	1.056	C
21-May	124	20.20	1.059	B
21-May	124	20.50	1.075	D
21-May	128	20.62	0.983	A
21-May	128	20.81	0.992	B
21-May	127	20.84	1.017	C
21-May	129	21.11	0.983	B
21-May	128	21.61	1.030	C
21-May	125	22.15	1.134	C
21-May	130	23.47	1.068	D
21-May	135	24.38	0.991	D
21-May	138	25.65	0.976	B
21-May	139	29.01	1.080	C
21-May	153	32.08	0.896	C
21-May	149	37.13	1.122	B

Appendix 16. (continued)

Date	Nose-Fork Length (mm)	Weight (g)	K Value	Condition Factor
29-May	81	5.60	1.054	B
29-May	80	5.72	1.117	C
29-May	83	5.80	1.014	C
29-May	80	5.95	1.162	B
29-May	82	6.29	1.141	C
29-May	86	6.78	1.066	C
29-May	89	7.21	1.023	C
29-May	87	7.22	1.096	A
29-May	86	7.33	1.152	A
29-May	88	7.52	1.103	B
29-May	88	7.55	1.108	B
29-May	87	7.59	1.153	A
29-May	88	7.64	1.121	C
29-May	88	7.65	1.123	B
29-May	89	7.75	1.099	A
29-May	90	7.80	1.070	D
29-May	90	7.90	1.084	C
29-May	91	8.00	1.062	B
29-May	91	8.06	1.070	B
29-May	91	8.09	1.074	B
29-May	91	8.30	1.101	A
29-May	90	8.37	1.148	B
29-May	94	8.42	1.014	C
29-May	91	8.45	1.121	A
29-May	92	8.64	1.110	A
29-May	93	8.80	1.094	A
29-May	93	8.86	1.102	B
29-May	94	9.04	1.088	B
29-May	94	9.14	1.100	B
29-May	95	9.38	1.094	D
29-May	92	9.40	1.207	B
29-May	94	9.62	1.158	D
29-May	101	9.81	0.952	A
29-May	99	10.12	1.043	A
29-May	101	10.58	1.027	C
29-May	100	10.62	1.062	B
29-May	102	10.74	1.012	C
29-May	103	10.81	0.989	C
29-May	98	10.91	1.159	A
29-May	100	11.11	1.111	D

Appendix 16. (continued)

Date	Nose-Fork Length (mm)	Weight (g)	K Value	Condition Factor
29-May	103	11.76	1.076	B
29-May	105	13.12	1.133	D
29-May	106	13.71	1.151	D
29-May	110	13.98	1.050	C
29-May	114	15.98	1.079	C
29-May	118	16.27	0.990	C
29-May	117	16.28	1.016	A
29-May	114	16.86	1.138	D
29-May	122	17.35	0.955	B
29-May	118	17.49	1.064	C
29-May	121	18.80	1.061	A
29-May	128	21.21	1.011	C
29-May	128	21.51	1.026	B
29-May	123	23.81	1.280	C
Minimum	75	4.89	0.745	
Maximum	153	37.13	1.280	
Mean	106.5	13.31	1.040	
SD	16.6	5.96	0.076	

Appendix 17. Annual transport of adult coho and steelhead salmon upstream of the Cleveland dam.

Year	Coho		Steelhead
	Jack	Adult	
2001	734	4,074	0
2000	68	2,787	0
1999	434	1,604	0
1998	299	553	0
1997	17	1,202	0
1996 to 1977		See Note Below	
1976		1,832	0
1975		See Note Below	
1974		3,450	0
1973		325	0
1972		687	5
1971		3,053	56
1970		2,617	76
1969		1,320	64
1968		1,473	87
1967		1,203	127
1966		2,091	84
1965		617	49
1964		2,623	125
1963		2,103	96
1962		2,636	87
1961		2,119	39
1960		3,663	160
1959		2,785	214
1958		3,789	95
1957		5,132	78
1956		1,864	66
1955		5,007	129
1954		2,967	44

Note: Transporting of adult salmon upstream of the dam did not occur in 1975 and from 1977 to 1996 inclusive.
Source: http://www-heb.pac.dfo-mpo.gc.ca/facilities/Capilano/fp_hist_adult_transport_e.htm

Appendix 18. Historical releases of fed and unfed coho and steelhead salmon fry from the Capilano Salmon Hatchery.

Release Year	Coho		Steelhead	
	Upstream of Cleveland Dam	Downstream of Cleveland Dam	Upstream of Cleveland Dam	Downstream of Cleveland Dam
2001	406,659 ('00)	0	73,281 ('01)	0
2000	255,200 ('99)	25,087 ('99)	22,736 ('00)	0
1999	221,707 ('98)	31,019 ('98)	12,607 ('99)	0
			14,413 ('98)	
1998	54,582 ('97)	70,626 ('97)	46,859 ('98)	0
1997	0	0	31,509 ('97)	0
1996	148,294 ('95)	36,583 ('95)	9,161 ('96)	0
1995	82,099 ('94)	28,305 ('94)	10,636 ('95)	6,757 ('95)
			779 ('94)	1,834 ('94)
1994	168,311 ('93)	30,978 ('93)	18,867 ('94)	0
1993	0	0	28,207 ('93)	0
1992	93,516 ('91)	0	3,356 ('92)	0
			18,889 ('91)	
1991	0	0	0	0
1990	58,223 ('89)	0	8,914 ('89)	1,000 ('89)
1989	0	0	26,187 ('89)	8,207 ('89)
			25,289 ('88)	
1988	156,299 ('87)	0	25,009 ('88)	0
			14,549 ('87)	
1987	99,773 ('86)	0	25,304 ('87)	1,925 ('86)
1986	165,275 ('85)	0	15,807 ('86)	1,373 ('85)
			19,354 ('85)	
1985	495,061 ('84)	0	8,004 ('84)	0
1984	501,148 ('83)	0	121,695 ('84)	10,906 ('83)
			14,314 ('83)	
1983	430,764 ('82)	0	42,577 ('83)	0
1982	836,321 ('81)	56,837 ('81)	16,747 ('82)	0
1981	76,353 ('80)	1,032	0	0
1980	263,405 ('79)	0	14,263 ('80)	0
			34,730 ('79)	
1979	429,157 ('78)	0	0	15,343 ('78)
1978	379,724 ('77)	0	28,241 ('78)	0
1977	439,177 ('76)	0	0	0

Note: Brood years of respective releases are in brackets.

Source: http://www-heb.pac.dfo-mpo.gc.ca/facilities/Capilano/fp_hist_fry_releases_e.htm